NPS67-82-002CR

NAVAL POSTGRADUATE SCHOOL

Monterey, California

CONTRACTOR REPORT

PERFORMANCE OF SOLID FUEL RAMJET
GUIDED PROJECTILE FOR USN
5"/54 GUN SYSTEM

ODED AMICHAI

March 1982

Prepared for:
Naval Postgraduate School
Monterey, California 93940

NAVAL POSTGRADUATE SCHOOL
Monterey, California

Rear Admiral J. J. Ekelund
Superintendent

D. A. Schrady
Acting Provost

The work reported herein was carried out for the Naval Postgraduate School by Oded Amichai under Contract Number N00228-81-C-H231. The work presented in this report is in support of solid fuel ramjet research and the exploration of Navy applications for Advanced Indirect Fire Support, AIFS. Both projects are funded by the Defense Advanced Research Projects Agency and are under the cognizance of Professor A. E. Fuhs.

This report was prepared by:

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

RMS REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER NPS67-82-002CR	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) PERFORMANCE OF SOLID FUEL RAMJET GUIDED PROJECTILE FOR USN 5"/54 GUN SYSTEM		5. TYPE OF REPORT & PERIOD COVERED Contractor Report
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Oded Amichai		8. CONTRACT OR GRANT NUMBER(s) N00228-81-C-H231
9. PERFORMING ORGANIZATION NAME AND ADDRESS Naval Postgraduate School Monterey, California 93940		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS DARPA ORDER 4035 ELEMENT: 62702E
11. CONTROLLING OFFICE NAME AND ADDRESS Defense Advanced Research Projects Agency 1400 Wilson Boulevard Arlington, Virginia 22209		12. REPORT DATE March 1982
		13. NUMBER OF PAGES 207
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report) UNCLASSIFIED
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release, distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

guided projectiles, precision guided munitions, guns, gun launched ramjet, soldi fuel ramjets, antiship missile defense.

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report covers work done on performance analysis of a 5 inch, 54 caliber gun-launched guided projectile with solid fuel ramjet (SFRJ).

A computer program (TRAJET) was developed. The program contains ramjet and trajectory analysis. The ramjet part considers conical shock wave losses, inlet boundary layer losses, normal shock losses, subsonic diffuser recovery, expansion into combustor losses, heat losses at the combustor and nozzle losses

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20. Abstract continued:
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It was found that the cowl drag coefficient has a major influence on the results. Therefore, a separate program (AERO) was developed to calculate this parameter.

The 5"/54 solid fuel ramjet has a capability to produce fuel specific impulse in the order of 400 - 900 sec. depending mostly on the flight altitude. The thrust coefficient varies in the range of 0.3 ± 0.1 depending on the internal areas.

A range in the order of 50 miles can be achieved with the ramjet operation compared to only 13 miles achieved by the conventional projectile. At low-altitude launch, a range of over 18 miles can be reached in Air-Defense Scenario. The ramjet propelled projectile reaches the ranges mentioned above at high Mach numbers ($M_0 \geq 1.8$). It is, therefore, clear that the ramjet concept provides significant improvement and has an Anti-Ship Missile Defense (ASMD) capability.

ACKNOWLEDGMENT

The author wishes to express his sincere appreciation to Distinguished Professor Allen E. Fuhs for his invaluable guidance, help and friendship.

The author would also like to express his gratitude for Professor T. H. Gawain for his assistance and cooperation in calculating the cowl drag coefficient.

The author also gives his thanks to Professor D.W. Netzer for his technical assistance.

The author would like to thank Mr. Uri Katz for his help and for the fruitful discussions we had during his stay as a research associate at the Naval Postgraduate School.

The illustrations and graphic arts for this report were accomplished by Don Jacobs of the Naval Postgraduate School Educational Media Department. His help is appreciated.

ABSTRACT

This report covers work done on performance analysis of a 5 inch, 54 caliber gun-launched guided projectile with solid fuel ramjet (SFRJ).

A computer program (TRAJET) was developed. The program contains ramjet and trajectory analysis. The ramjet part considers conical shock wave losses, inlet boundary layer losses, normal shock losses, subsonic diffuser recovery, expansion into combustor losses, heat losses at the combustor and nozzle losses.

A flat earth trajectory with drag and thrust was considered. The various drag coefficients which were considered are: cowl drag coefficient, skin drag coefficient, wing (or fin) wave drag coefficient and wing (or fin) friction drag coefficient. Base drag is assumed to be zero due to the jet from ramjet nozzle.

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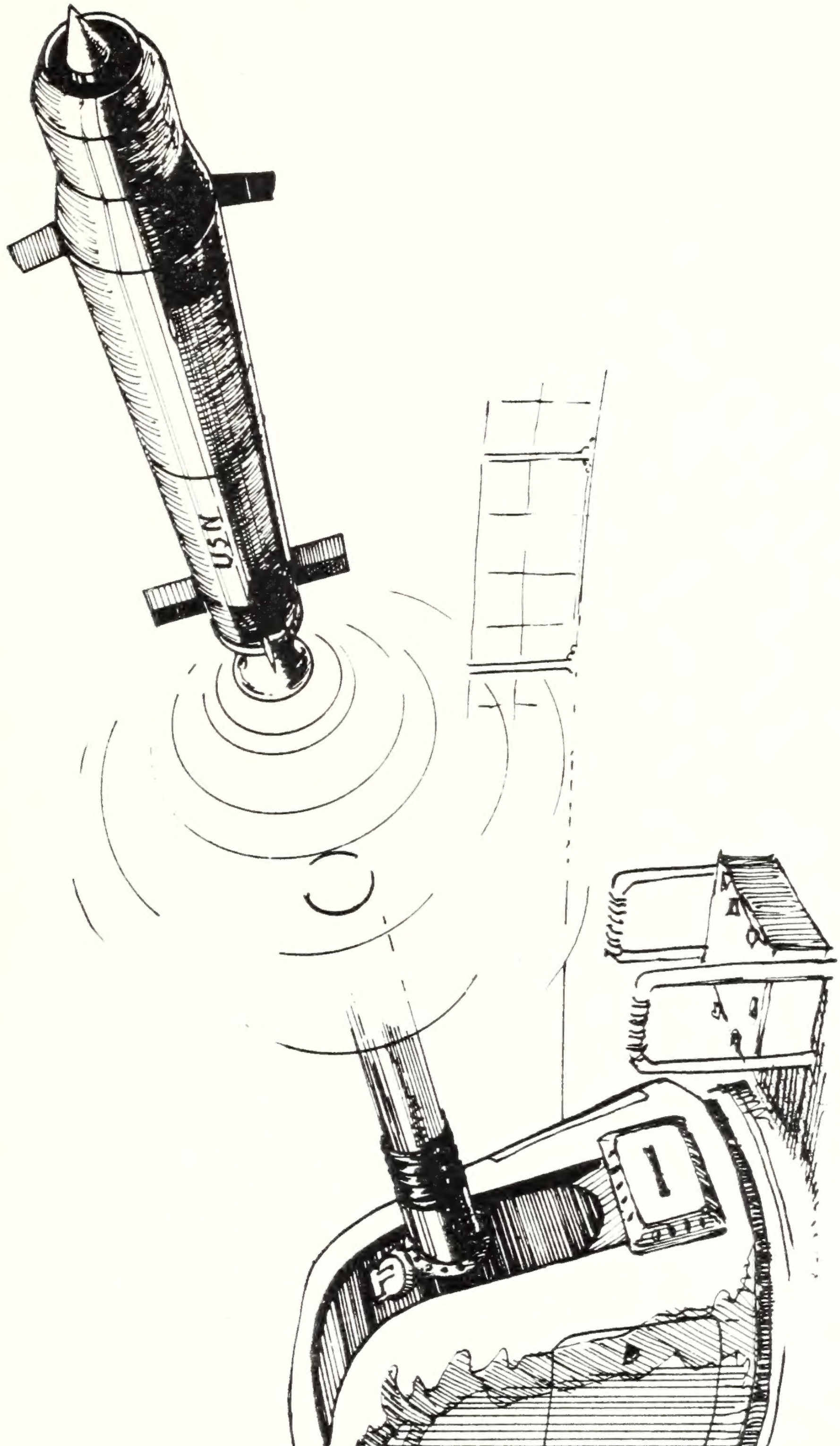
A range in the order of 50 miles can be achieved with the ramjet operation compared to only 13 miles achieved by the conventional projectile. At low-altitude launch, a range of over 18 miles can be reached with the ramjet version. Launches at high elevation angles can be useful in air-defense scenario. The ramjet propelled projectile reaches the ranges mentioned above at high Mach numbers ($M_0 \geq 1.8$). It is, therefore,

clear that the ramjet concept provides significant improvement and has an Anti Ship Missile Defense (ASMD) capability.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1. INTRODUCTION

1.1 Background

This report covers work done on propulsion and flight mechanics of a gun-launched guided projectile. Gun-launched guided projectiles have been developed by Martia Marietta for the U.S. Army (Copperhead) [1,2] and more recently, also, for the U.S. Navy [3,4] (5"/54 Mark 46). The USN round has solid rocket propulsion.

The addition of a liquid fuel ramjet (LFRJ) to the Navy's version, was examined in the past by Brown [5]. This report concentrates on the addition of a solid fuel ramjet (SFRJ), instead.

It is believed that solid fuel ramjet has some potential advantages compared with the liquid fuel. Some of these advantages are:

- -Simple design
- -High reliability in operation
- -Low cost
- -Fuel control system not needed

On the other hand, there are also a few disadvantages to SFRJ compared to LFRJ. Some of these are:

- -Difficult to control magnitude of thrust
- -Difficulties in achieving high combustion efficiencies

In both cases, the addition of propulsion improves dramatically, the performance of the projectile by multiplication of range and enhanced maneuverability. Even more; to operate and produce thrust, the ramjet engine depends only on its forward motion at supersonic speeds and does not employ any moving parts. This fact, which is especially emphasized in SFRJ, leads to some advantages of the ramjet concept over the other

propulsion alternatives, at supersonic speed. On the other hand, the ramjet engine requires an auxiliary booster to accelerate it to its supersonic operating regime. The boost required causes some system difficulties. But, while solving these problems, the ramjet system becomes even more attractive for use with gun-launched guided projectile, like the U.S. Navy 5"/54.

A computer program was developed to analyze the performance of the SFRJ. The computer program was written for the IBM-370 computer at the Naval Postgraduate School, Monterey, California. HTPB was selected as a fuel, but performance with any other fuel can be tested, using the same model. A flat earth trajectory with drag and thrust was considered. Using solid fuel, a thrust-equal-drag trajectory is more difficult to achieve with SFRJ. Therefore, most of the results given in this report eliminate this case, and the exact value for drag, at each point, was calculated. However, if desired, it is possible to change the air mass flow, in order to obtain thrust-equal-drag flight. The computer program can calculate this case also.

1.2 Basic Concept

The ramjet engine consists of an air inlet, which serves as a diffuser, a combustion chamber, and an exhaust nozzle [6,7]. The diffuser admits air to the engine, which is mixed with fuel (solid or liquid) at the combustor. After the burning process, which adds heat to the flowing air within the system, the gases are transfered to the nozzle. The nozzle converts part of the thermal energy into kinetic energy to produce thrust.

The areas inside the ramjet engine are usually divided into six stations, as illustrated in Figure 1.1. Station 0 defines the cross-

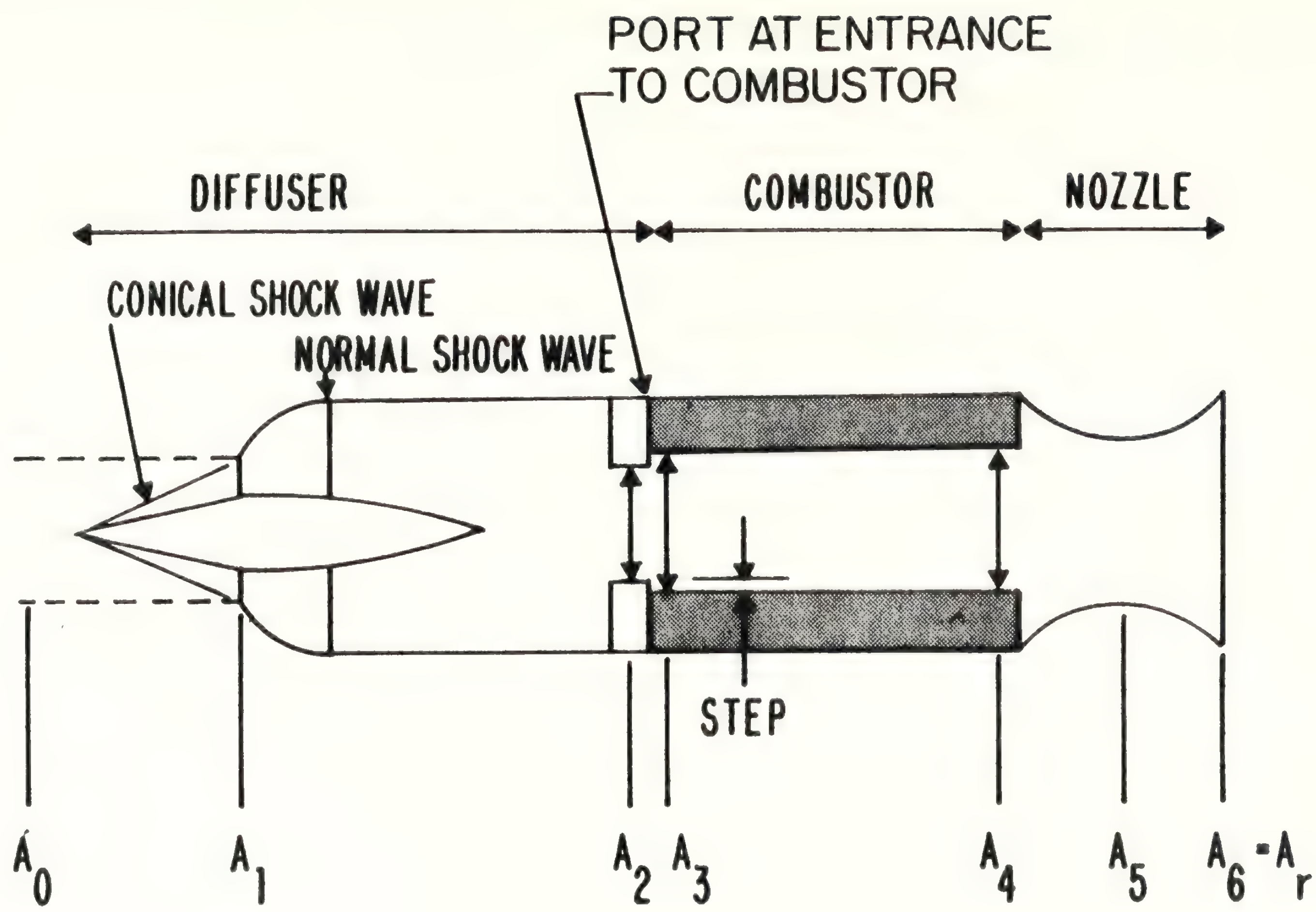
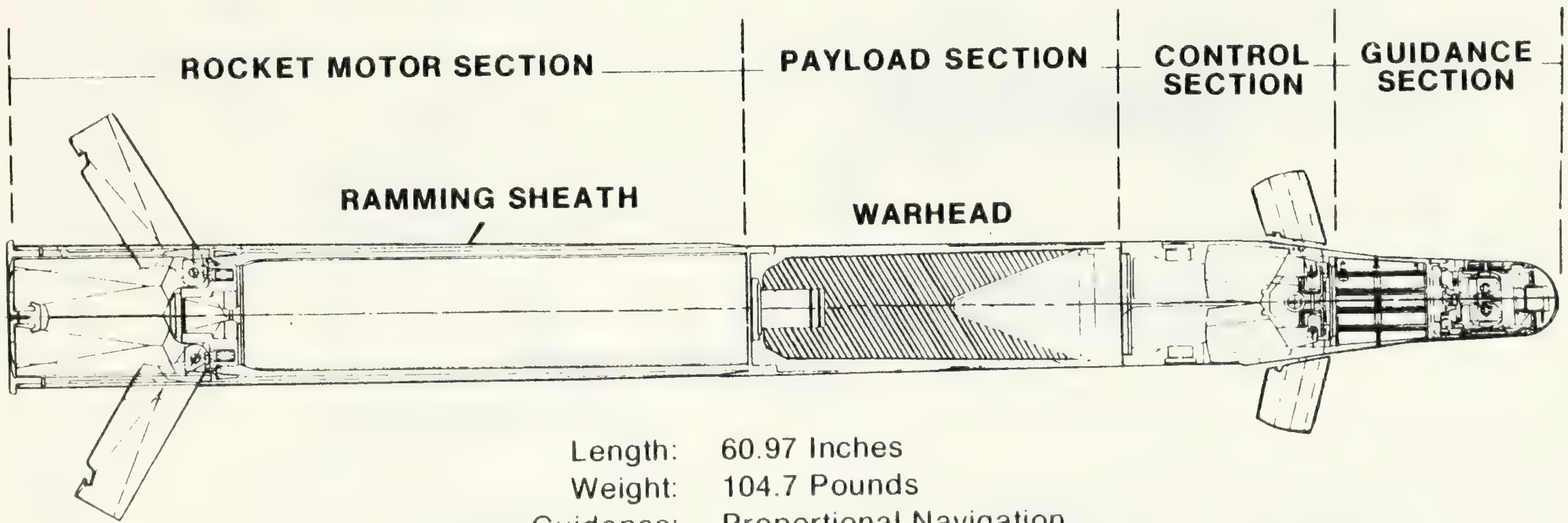


Figure 1.1 Schematic View of a Solid Fuel Ramjet

5-INCH GUIDED PROJECTILE



Length:	60.97 Inches
Weight:	104.7 Pounds
Guidance:	Proportional Navigation
Seeker:	Semiactive Laser
Controls:	Cold Gas Pneumatic

Figure 1.2 U.S. Navy 5"/54 Semi Active Laser Guided Projectile (SALGP).

section area of the stream tube captured by the inlet of the projectile. Stations 1 and 2 identify the diffuser. Station 1 itself is at the throat of the diffuser, but sub-station 1C is after the conical wave; sub-station 11 and S1 are ahead of the normal shock wave, located at the throat, or at the actual place, respectively; sub-stations 12 and S2 are as above, but behind the normal shock wave. Stations 3 and 4 refer to the entrance and to the exit of the fuel grain within the combustor, respectively. Note that both A_3 and A_4 increase with time as fuel burns. Station 5 and 6 belong to the nozzle's throat and to the exit of the nozzle, respectively.

1.3 Data

1.3.1 Dimensions

In order to be compatible with the Navy's 5 inch, 54 caliber, Mark 46 gun mount, as modified for gun launched guided projectiles (Figure 1.2), a set of requirements were adapted initially. These were:

a. External shape of existing 5" guided SAL projectile

b. Length - 60.97"

c. Length of combustion chamber - 23"

d. Total weight - 104.7 lb.

e. Muzzle velocity - 2500 ft/sec.

Typical values for the internal areas in the ramjet within the projectile are (units - sq. in.):

A_r	A_0	A_1	A_2	A_3	A_5	A_6
19.3	5.2	2.6	4.3	8.2	7.5	13.1

Refer to Figure 1.1 for definition of the areas. A_r is a reference area. For typical flight Mach number of: $M_0 = 3$, the appropriate Mach numbers at the main stations are typically:

M_{1C}	M_{11}	M_{12}	M_2	M_3	M_5	M_6
2.2	2.1	0.56	0.3	0.1	1	2

1.3.2 Combustion Process

Some of the losses in the total pressure were taken to be constant. These are:

a. Inlet boundary layer losses (π'_D; typically = 0.93).

b. Subsonic diffuser recovery (π''_D; typically = 0.93).

c. Nozzle losses (π_n; typically = 0.96).

These values are typical and are not expected to vary too much.

All the other losses in total pressure, which are dominant to the projectile performance, were calculated. These are:

a. Conical shock wave losses (π_C).

b. Normal shock losses (π_{NS}).

c. Losses due to expansion into the combustion chamber (π_e).

d. Heat losses in the combustion chamber (π_h).

See section A 1.4.2 for definition of various π . Combustion efficiency was taken constant: $\eta_T = 0.90$

Air heat capacity ratio was also taken constant: $\gamma_a = 1.4$; however, the value for the gas heat capacities ratio of the combustion products (γ_f) was calculated from thermodynamic data for Hydroxy Terminated Polybutadiene, HTPB, burned in air [8]. The stoichiometric chemical reaction of HTPB burning with oxygen is as follows:

$$4\ C_{73}H_{103}O_1 + 393\ O_2 \rightarrow 292\ CO_2 + 206\ H_2O \qquad (1.3.1)$$

1.3.3 Trajectory

In the trajectory part of the program, the various drag coefficients were calculated. Those are:

a. Cowl drag coefficient (C_{DN}), [9-12].

b. Skin drag coefficient (C_{DS}), [13-15].

c. Wing (or fin) wave drag coefficient (C_{DWW}), [16 - 20].

d. Wing (or fin) friction drag coefficient (C_{DWF}), [13, 19].

Base drag [13, 21-23] is assumed to be negligible due to the jet from ramjet nozzle.

The model, which was chosen to calculate the cowl (nose) drag coefficient, was based on a theoretical development done by T. H. Gawain [9]. The modified program (AERO) is listed in Appendix G. However, program AERO as it is, appears to be too long to be used directly in the main program (TRAJET). Therefore, best fit curves for calculated results from AERO were used in TRAJET.

Skin drag coefficients were calculated for either laminar or turbulent flows. The same routine was also used to calculate wing or fin friction drag coefficients. To calculate the wing wave drag coefficients, a psuedo 3-dimensional model was developed.

The program also has an option to calculate a trajectory of a projectile without propulsion. In this case, the drag coefficients which are calculated are:

a. Nose drag coefficient (a different model than the above).

b. Base drag coefficient

c. Skin drag coefficient (as above).

1.3.4 Air Defense Scenario

In the air defense scenario, the program takes into account only cases in which the projectile exceeds a Mach number of at least 1.8. This value of minimum Mach number (XM_0) can easily be changed.

1.4 Results

Each section of the program was developed, tested and run separately. The ramjet part was first run without the trajectory part using

constant altitude (Typically - 10,000 ft). The same was done with the trajectory part using vacuum case, thrust-equal-drag flight, or constant thrust case. The final version was programmed to give the following optional printings:

a. Loop on all possible values of A_0/A_r and A_5/A_r and print summary tables only.

b. Print detailed, time dependent, tables for any specific area ratio chosen:

  - Results from combustion process (file name: CMB D)
  - Results from trajectory process (file name: TRJ D)
  - Various drag coefficients (file name: DRG D)

c. Detailed print of every step during the calculation, for checkup.

d. Variation of the above:

  Detailed print of cases that were found not to be suitable:

  - Reasons only
  - Full detailed parameters
  - Loop on Mach numbers, also (output of subroutine CALCM)

2. TYPICAL RESULTS

Figure 2.1 presents the dependence of the fuel specific impulse (I_{sp}, in sec.) of the ramjet on the projectile Mach number at various altitudes. It appears that the 5"/54 ramjet has a capability to produce fuel specific impulse in the order of 400 - 900 sec., depending mostly on the flight altitude. The dependence of I_{sp} on the flight Mach number is weak.

Figures 2.2 and 2.3 present the dependence of the thrust coefficient (C_f) on the internal area ratios A_0/A_r and A_5/A_r. In figure 2.2, the change of C_f with altitude and with Mach number is also presented. The thrust coefficient (C_f) varies in the range of 0.3±0.1 while A_0/A_r changes from 0.25 to 0.40 and A_5/A_r changes from 0.42 to 0.26.

The correlation between the fuel specific impulse (I_{sp}) and the thrust coefficient (C_f) is presented in figures 2.4 and 2.5. In both figures, a Mach number of M_0 = 3.0 was selected. In figure 2.4, the correlation was checked at various altitudes and at various A_0/A_5 area ratios. In figure 2.5, various internal area ratios (A_0/A_r, A_5/A_r) are presented.

More detailed results are presented in Appendix H. The dependence of the projectile performance on the other internal area ratios (A_1/A_0, A_2/A_0, A_3/A_r) was also checked. Some typical results are presented in that Appendix.

An altitude vs range dependence for various elevation angles is presented in figure 2.6. A range of over 80 km can be achieved with the ramjet operation, compared to only slightly more than 20 km achieved by the conventional projectile. A low-altitude launch (in this figure, an elevation angle of 15° was selected) is also presented reaching a range of over 30 km with the ramjet operation. The high elevation angles are mostly used in air-defense scenario. The drag of the projectile when the ramjet is not operating, for example,

after burnout, was not determined. The computer program does not account for the drag increase due to the ramjet not operating. Consequently some of the trajectory curves in figure 2.6 are in error. However, for trajectories at low gun elevation, the ramjet burns all the way to splash. These trajectories are accurate. For all trajectories, the curves are accurate to the point of ramjet burnout. The trajectories of interest to air defense are accurately calculated. Trajectory of thrust-equal-drag (vacuum) case is shown for comparison.

Results for air defense scenario are presented in figure 2.7. Only ranges where the projectile Mach number exceeds at least 1.8 where considered. The area ratios where chosen as specified in the figure. The two cowl angles, shown in figure 3.1 were 20° and 9.5° respectively. The gun elevation angle was varied from 7° to 80°. The change of atmospheric conditions with the altitude was taken into account. In table 2.1, some typical results for "Surface-to-Surface Mission" are presented.

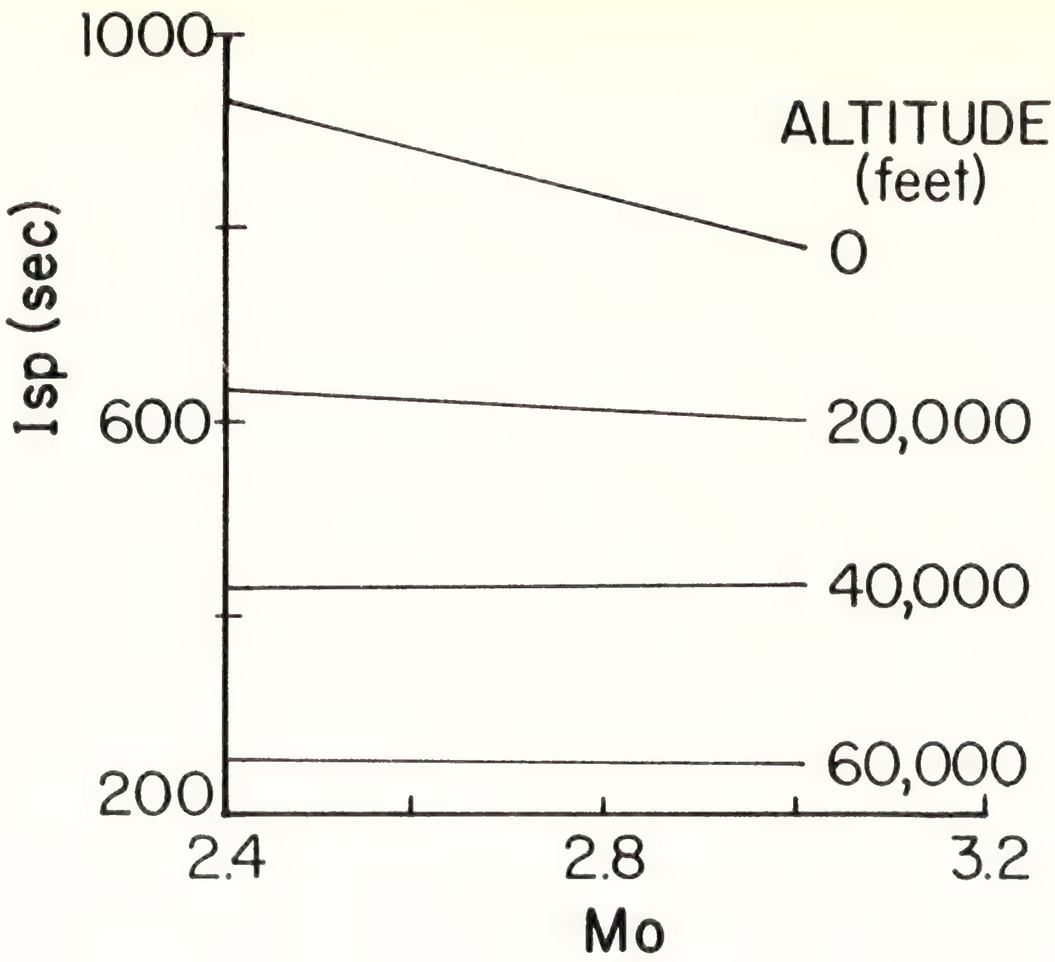


Figure 2.1 Solid Fuel Ramjet: Dependence of Fuel Specific Impulse (I_{sp}) on Flight Mach Number at Various Altitudes

Conditions: $A_0/A_r=0.25$, $A_1/A_0=0.47$, $A_2/A_0=0.827$

$A_3/A_r=0.427$, $A_5/A_r=0.28$, $A_6/A_r=1$, $\theta=45°$, $t=0$

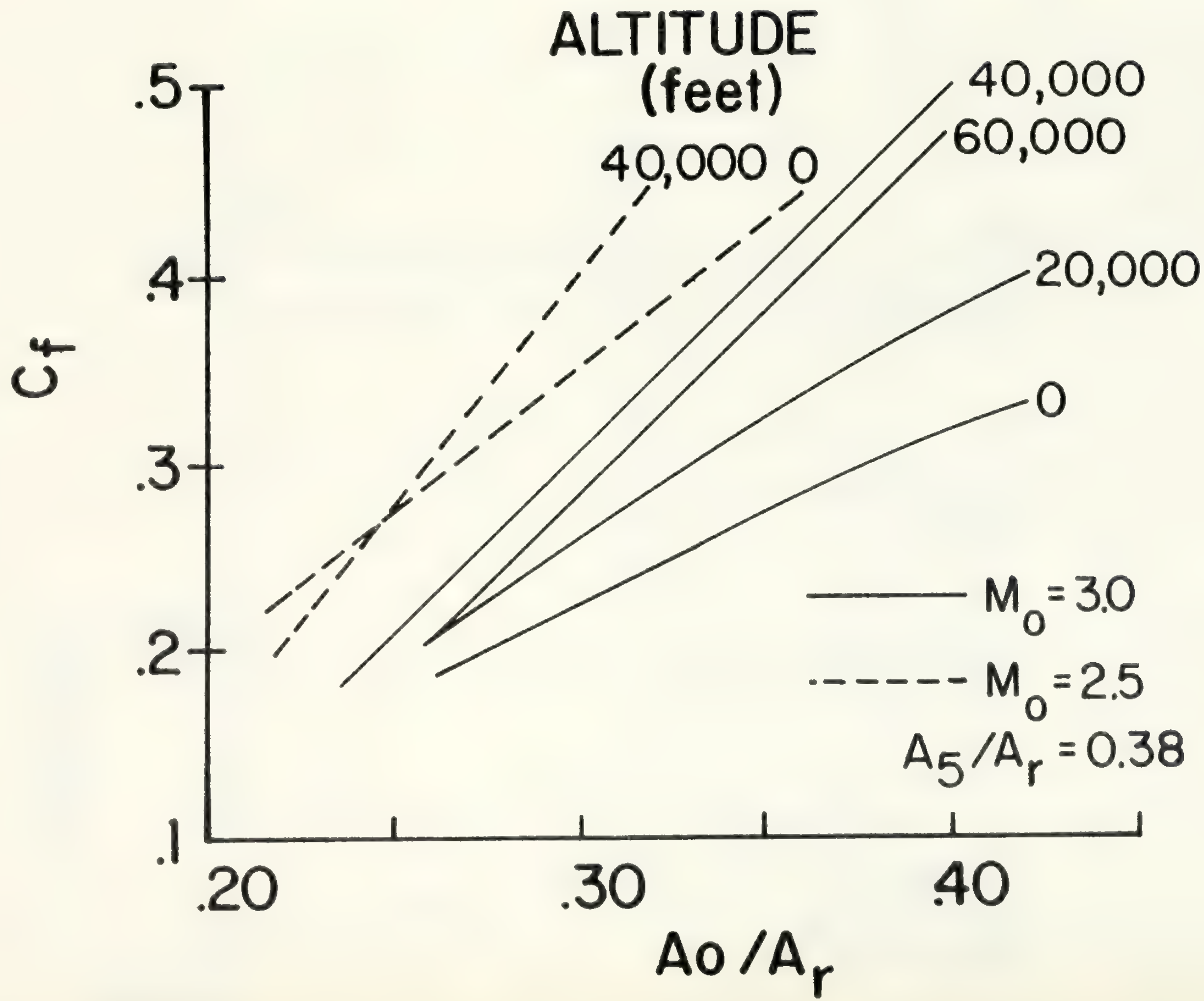


Figure 2.2 SFRJ: Dependence of Thrust Coefficient on Internal Area Ratio (A_0/A_r) at Various Altitudes

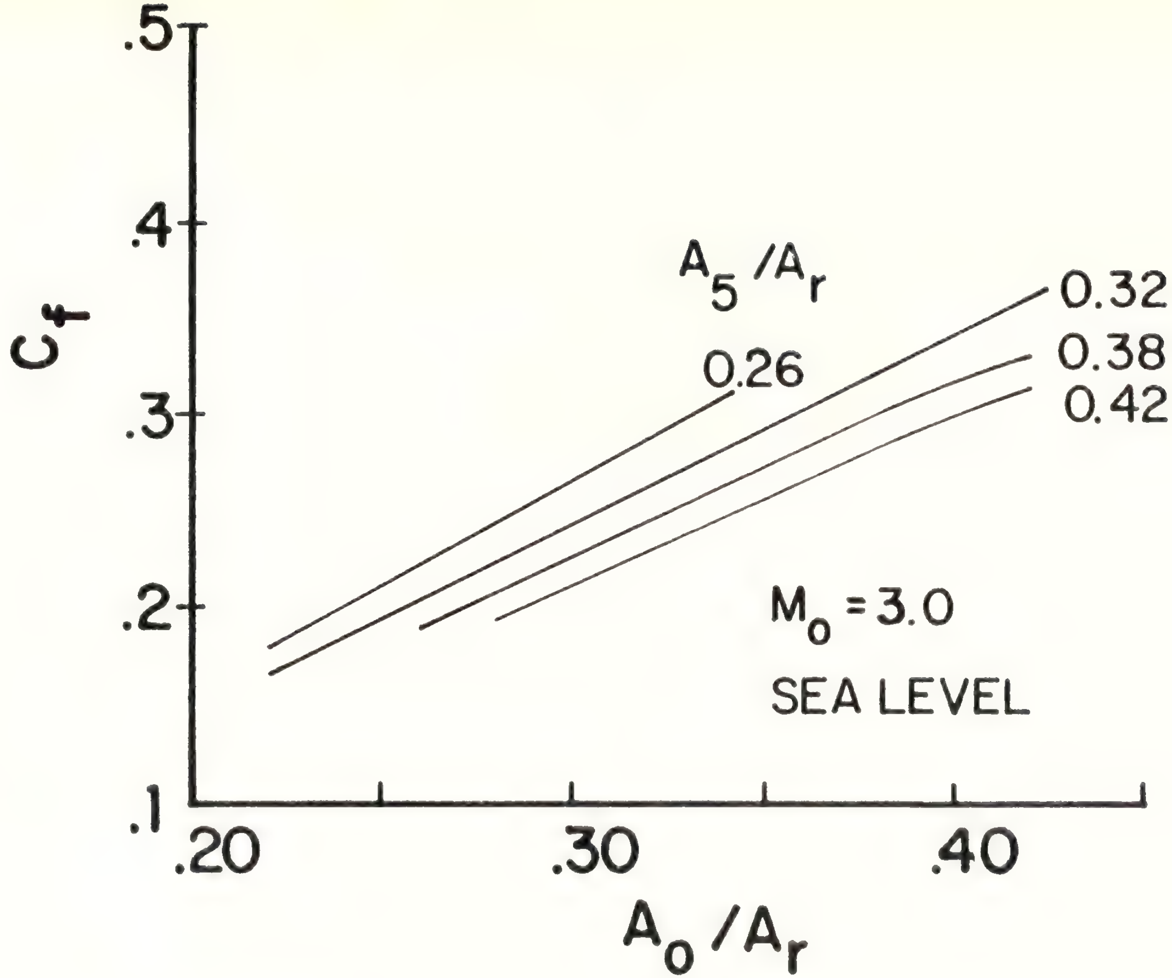


Figure 2.3 SFRJ: Dependence of Thrust Coefficient on Inlet and on Nozzle Area Ratios

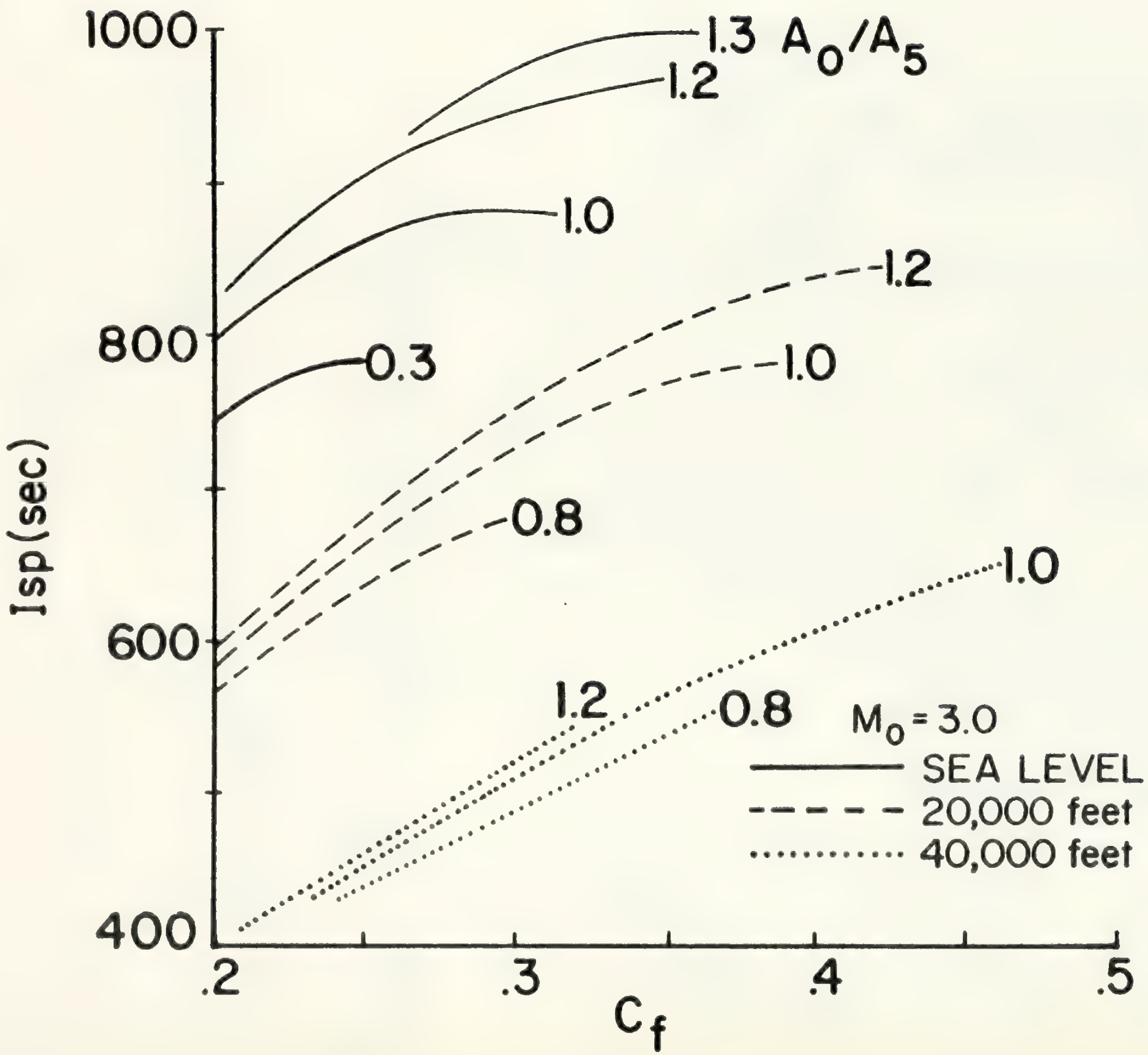


Figure 2.4 SFRJ: Dependence of Fuel Specific Impulse (I_{sp})

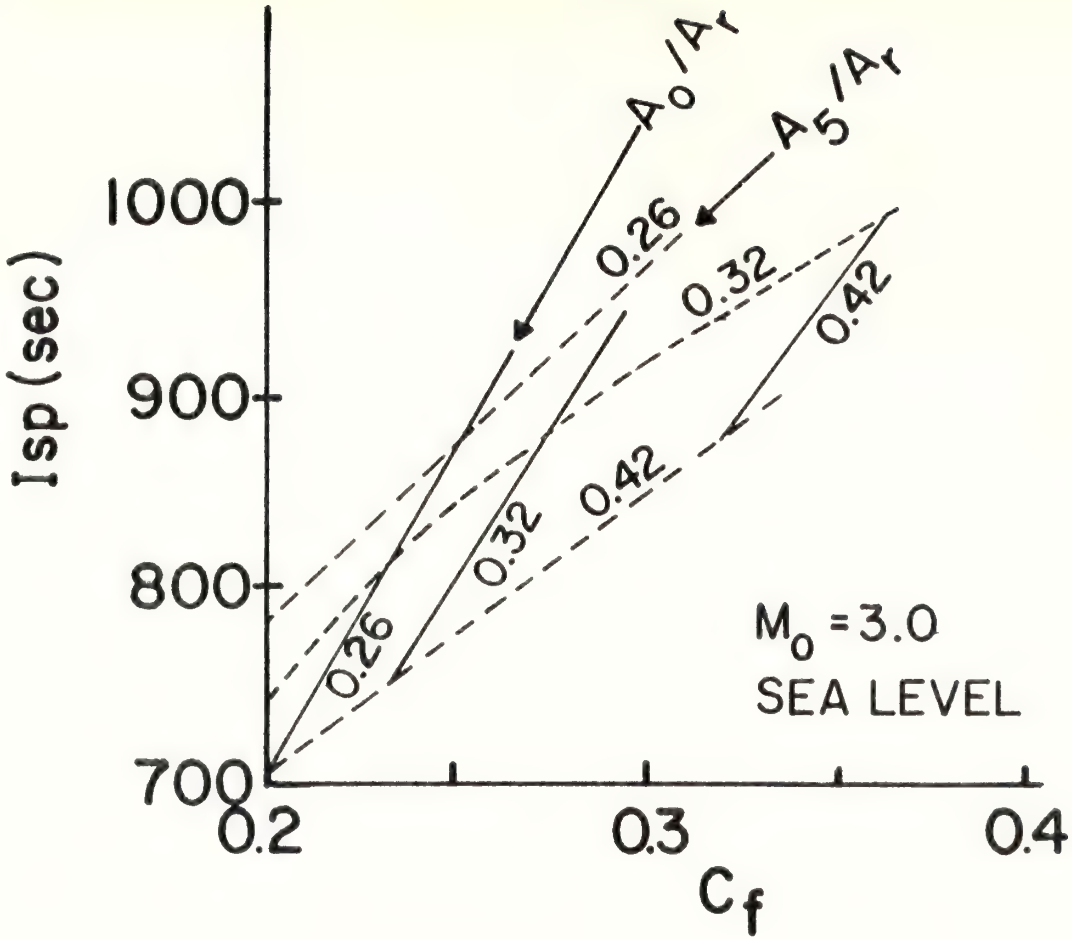


Figure 2.5 SFRJ: Dependence of Fuel Specific Impulse (I_{sp}) on Thrust Coefficient at Various Internal Area Ratios

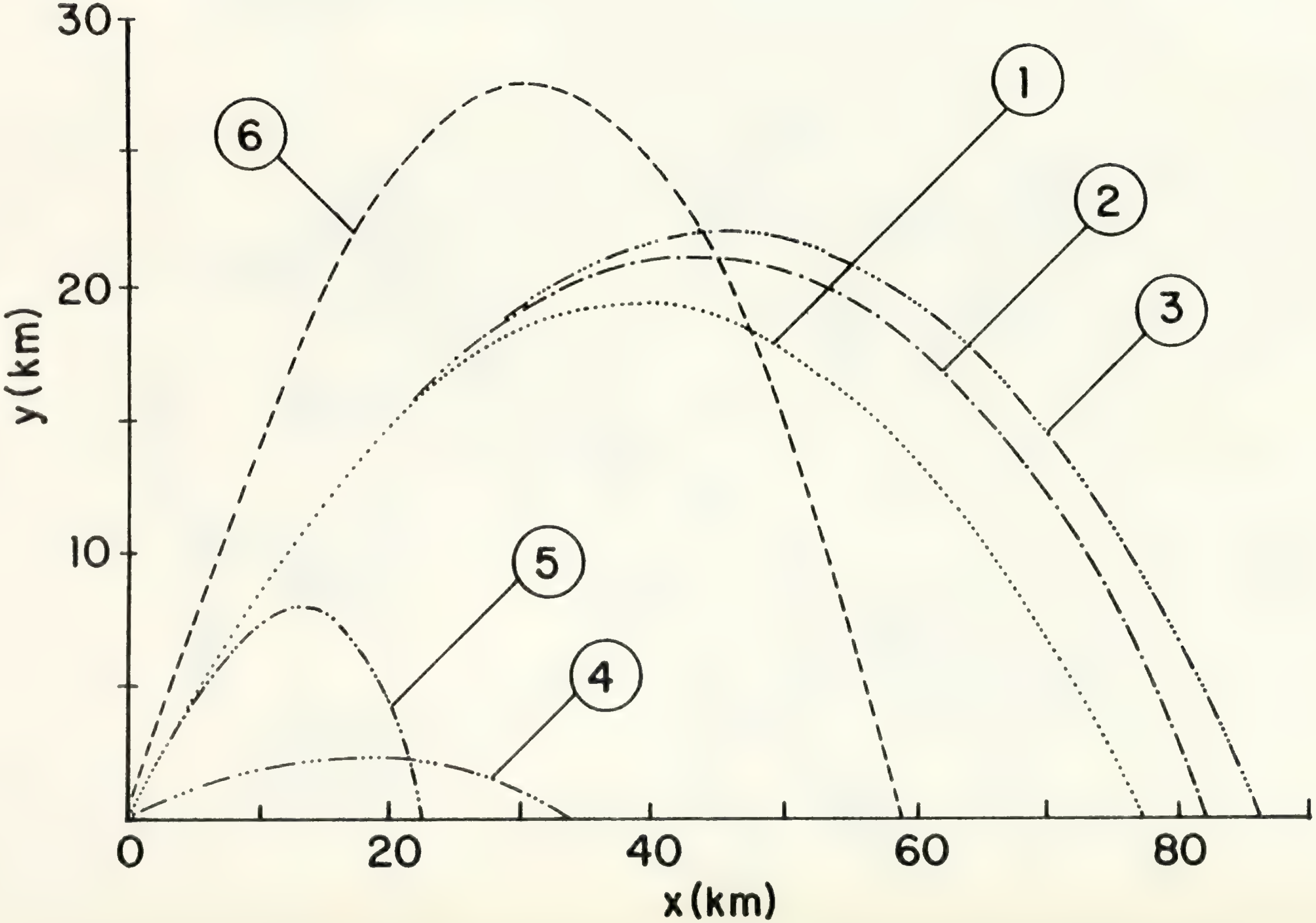


Figure 2.6 Comparison of Trajectory of SFRJ with Conventional Projectile at Various Conditions: (1) Thrust-Equal Drag (Vacuum); (2) SFRJ, $\theta=45°$: $A_0/A_r=0.28$, $A_1/A_0=0.42$, $A_2/A_0=0.827$, $A_3/A_r=0.426$, $A_5/A_r=0.26$, $A_6/A_r=1$; (3) As in (2), but: $A_1/A_0=0.47$; (4) As in (3), but: $\theta=15°$; (5) Projectile without Propulsion, $\theta=45°$; (6) As in (3), but: $\theta=60°$, $A_{[illegible]}/A_{[illegible]}=0.25$

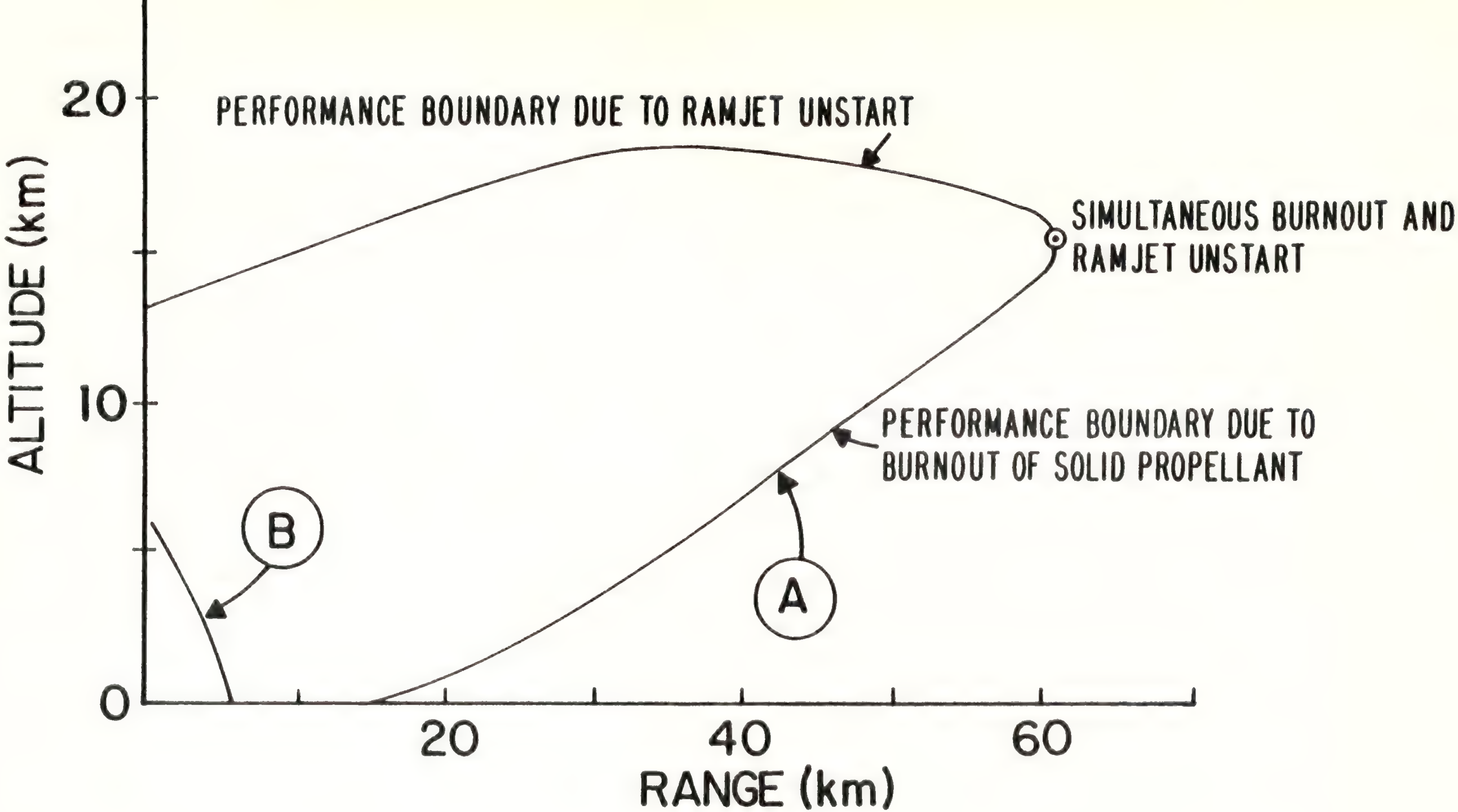


Figure 2.7 Solid Fuel Ramjet Propelled 5"/54 Projectile: Air Defense Mission

(A) Ramjet: $A_0/A_r=0.25$, $A_1/A_0=0.47$, $A_2/A_0=0.887$, $A_3/A_r=0.426$, $A_5/A_r=0.26$, $A_6/A_r=1.$ { $M_0(\text{Min}) = 1.8$ }

(B) Projectile Without Propulsion; Mach = 1.8 Boundary

TABLE 2.1

Solid Fuel Ramjet Propelled 5"/54 Projectile
Surface-to-Surface Mission
Ranges (km) vs Gun Elevation Angles

Elevation Angle	7°	25°	45°	65°	80°
a. Ramjet(1)	15.6	49.9	80.3	15.9	5.6
b. Projectile Without Propulsion	9.2	17.5	20.2	16.3	7.6

Note: 1. Area ratios as in Figure 2.7

3. Discussions

Looking back at figure 2.1, the dependence of I_{sp} on altitude and on Mach number should be explained. We shall do that by using the equations described in Appendix A.

From equations: (1.4.9a), (1.4.12), (1.4.16)

together with equations: (1.1.1), (1.1.2), (1.1.3)

one obtains:

$$I_{sp} = C_f \, X \, X_3 \qquad (3.1)$$

where:

$$X_3 = k_3 P_0^{0.4} M_0^{1.4} \qquad (3.2)$$

and:

$$C_f = X_2 - k_2 \qquad (3.3)$$

where:

$$X_2 = k_1 M_0^{-2} [X_1 - 1] \qquad (3.4)$$

$$X_1 = k_4 M_0 [1 + k_5 (P_0 \, M_0)^{-0.4}] \qquad (3.5)$$

The parameters k_1 to k_5 are functions of the various area ratios, the temperature of air (T_0), the heat capacity ratio of air (γ_a) and the perfect gas constant (R_a). These parameters are assumed to be constants in discussing the influence of the change in altitude and in Mach number on the value of I_{sp}. The altitude dependence is mainly due to change in atmospheric pressure (P_0). In the conditions chosen for figure 2.1, the dependence of I_{sp} on pressure is approximately $P_0^{0.4}$ at $M_0 = 3$. That means that, in the region mentioned, I_{sp} pressure dependence is mostly due to change of X_3 (equations 3.1 & 3.2). From the same equations, the Mach number dependence of I_{sp} can also be explained. At high altitude, the change of X_3 ($M_0^{1.41}$) is very close to the C_f dependence on Mach number ($M_0^{-1.3}$) and therefore I_{sp} is almost constant while changing M_0. On the other hand, at sea level, the change in $X_3(M_0^{1.35})$ is smaller than that of $C_f(M_0^{-2.14})$ and therefore I_{sp} changes with M_0 as shown in figure 2.1.

Figures 2.2 - 2.5 present similar dependences of the ramjet performance, and can well be understood using the same equations.

Testing these results, together with those presented in Appendix H, the design of the ramjet internal area ratios can be completed. The results are listed in Table 3.1.

Table 3.1: Ramjet Design

Dimensions:

External diameter = 5"

Total length = 60.97"

Total weight = 104.7 lb (47.5 kg)

Area Ratios:

A_0/A_r	A_1/A_0	A_2/A_0	A_3/A_r	A_5/A_r	A_6/A_1
0.25	0.47	0.887	0.426	0.26	1

Reference Area:

A_r = 19.3 sq. in. (124.5 cm^2)

Combustor

Solid fuel: Hydroxy Terminated Polybutadiene (HTPB).

Fuel weight: 3 kg

Fuel density: 971.56 kg/m^3

Fuel specific impulse (I_{sp}): 400 - 900 sec.

Booster

Booster weight: 2 kg

Booster density: 1650 kg/m^3

Booster specific impulse (I_{sp}): 240 sec

Performance

Muzzle velocity: 762 m/sec

Velocity after booster: 863 m/sec

Thrust Coefficient (C_f): 0.2 - 0.4

In figures 3.1 - 3.4, the designed ramjet concept is presented. The guidance and the control sections as well as the warhead were not redesigned. The location of the tailfin is described in figures 3.3 - 3.4 [White,24]. The configuration of the solid fuel ramjet presented here, is in accordance with the design of the liquid fuel ramjet done previously by Brown [5]. The new design is also in agreement with the Navy's requirement to be compatible with its 5"/54 Mark 46 gun mount, as modified for gun launched guided projectiles.

Figure 2.6 presents a full-range comparison of the SFRJ 5"/54 projectile performance with that of the conventional projectile. The improvement in performance of the ramjet-propelled, guided projectile is very significant. The extended range of the ramjet concept can be used in a "Surface-to-Surface Mission" (Table 2.1). The main improvement of the ramjet concept might be in an "Air-Defense Mission" (figure 2.7). A minimum Mach number of $M_0 = 1.8$ was assumed for both the ramjet concept and the conventional projectile. At lower altitudes, the projectile is limited by burn-out of the fuel. At higher altitudes, the performance boundary is due to ramjet unstart. The conventional projectile is limited by the Mach number decay to values less than 1.8. It is self-evident that the ramjet concept provides significant improvement, and, therefore, has significant ASMD Capability.

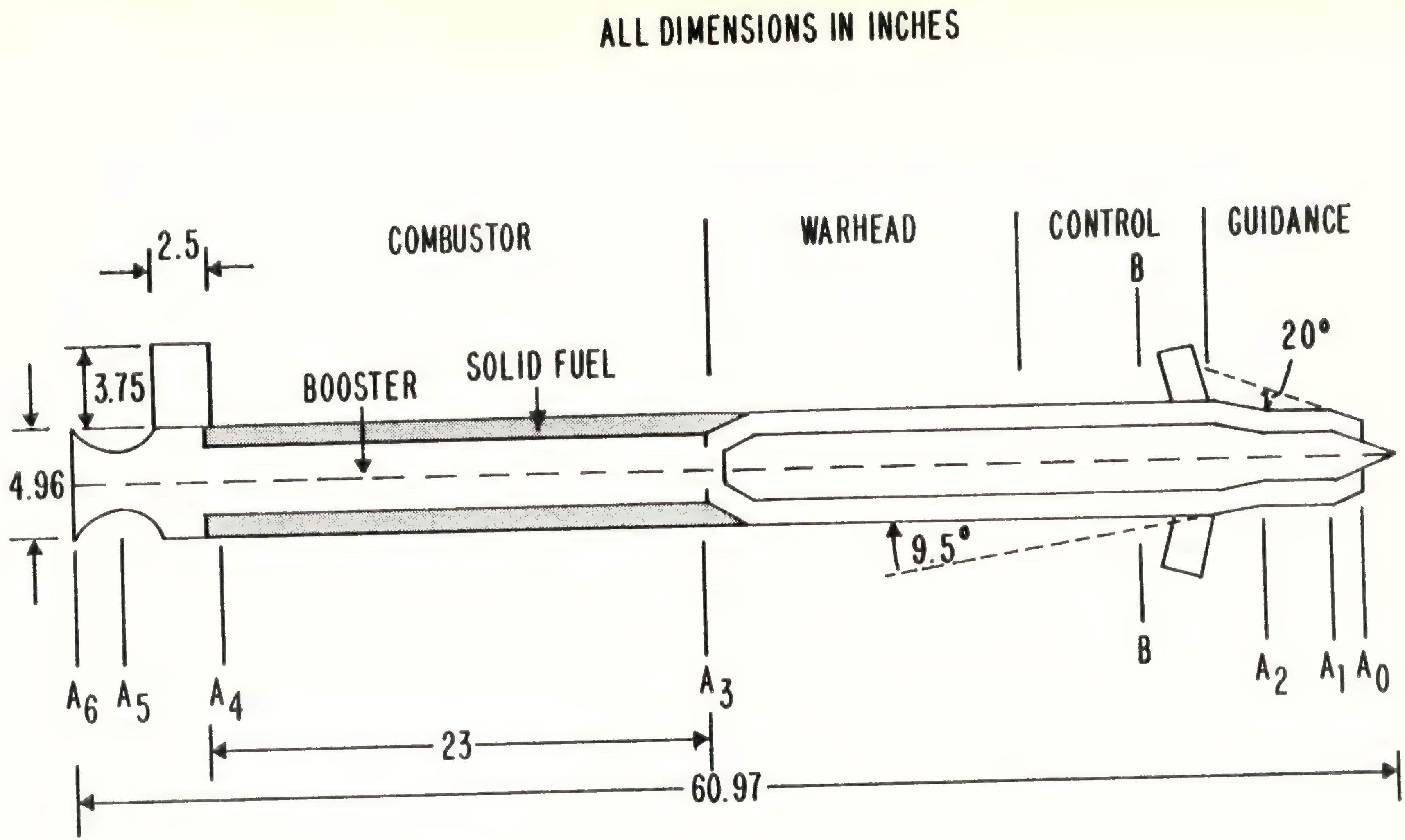


Figure 3.1 Solid Fuel Ramjet Propelled 5"/54 Projectile: Design

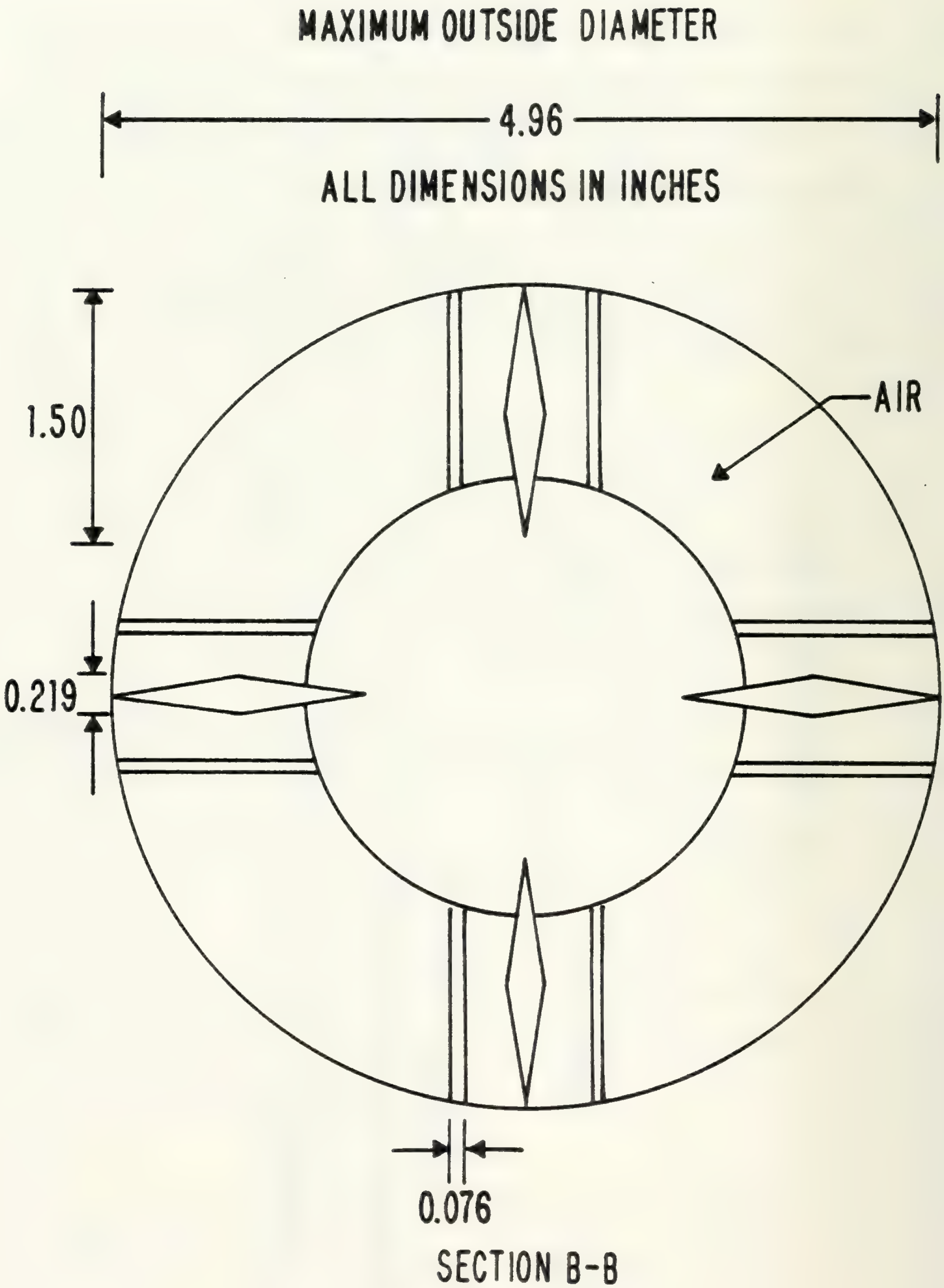


Figure 3.2 Solid Fuel Ramjet Propelled 5"/54 Projectile: Design, Section B-B

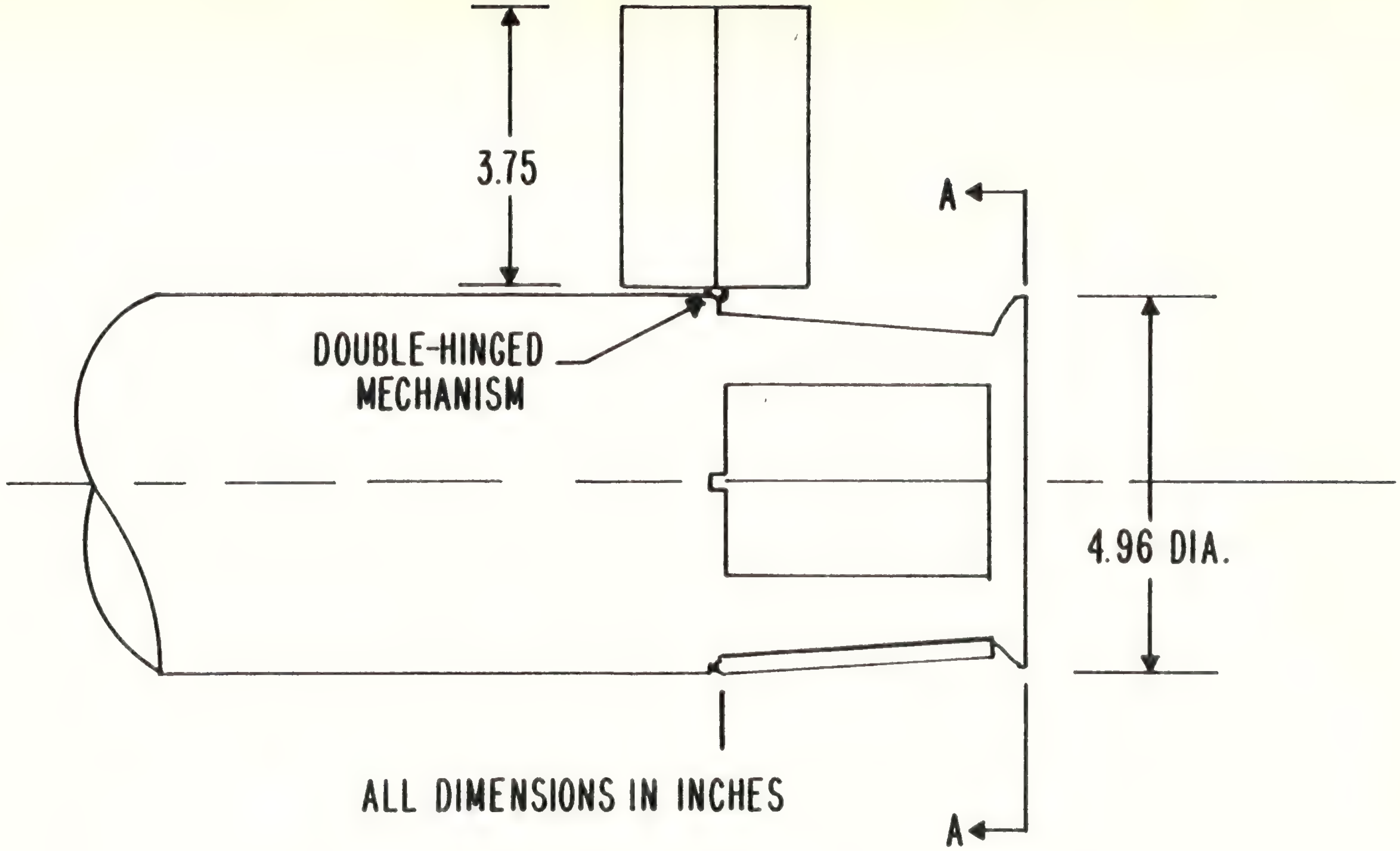


Figure 3.3 Aft Body Fin Design [24]

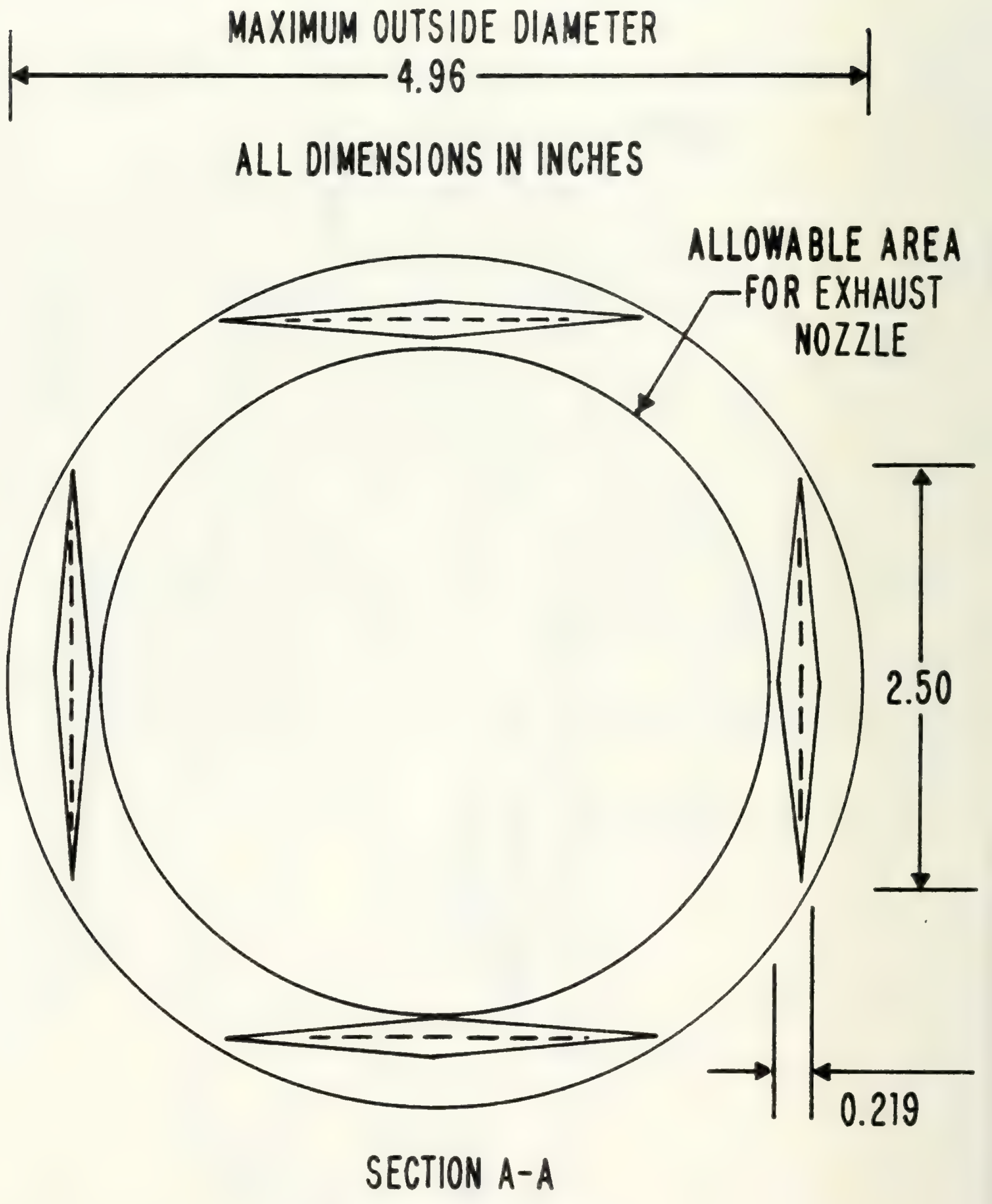


Figure 3.4 Aft Body Fin Design: Section A-A [24]

4. Conclusion

Based on the computer model discussed above, the ramjet-propelled, guided projectile provides significant improvement over the conventional projectile. The fuel specific impulse of the SFRJ is in the order of 600 ±200 sec, depending mainly on the altitude of the projectile. The appropriate value of the rocket is only 300 sec. The thrust coefficient varies from 0.2 to 0.4, depending on the atmospheric conditions (altitude) and on the geometry of the projectile (internal areas). Therefore, the ramjet-propelled, guided projectile reaches a range of about 80 km compared to range of slightly more than 20 km in the conventional projectile. The improvement of the ramjet concept might be in both "Surface-to-Surface Mission" and in "Air-Defense Mission". It provides an ASMD weapon which is complementary to guided missiles.

More work is required to design an optical system incorporated into the inlet. For satisfactory ramjet performance at the flight Mach numbers, the lens must be a conical shape.

A1. Combustion

A1.1 Computation of fuel - regression rate, weight rate of burning fuel, and fuel - air ratio

Define G as the weight flow rate of air per unit through the entrance port to the combustor; see figure 1.1. Hence G is given by:

$$G = \frac{\dot{W}_a}{A_3} \qquad (1.1.1)$$

and has dimensions of $lb/sec.in^2$. The simple form of the regression rate of a solid fuel, $\dot{r}$, is given by:

$$\dot{r} = aG^n \qquad (1.1.2)$$

Where a and n are empirically determined constants. The dimensions for $\dot{r}$ are in/sec. Knowledge of the temperature dependence of the regression rate will allow the use of a more accurate model instead of equation (1.1.2).

The weight of fuel burned per unit of time is as follows:

$$\dot{W}_f = \rho_f \dot{r} \pi D_3 L_3 \qquad (1.1.3)$$

Where ρ_f is the density of the fuel in lb/in^3, D_3 is the inside diameter of the fuel grain. Note that D_3 increases as the fuel burns. The length of fuel grain is L_3 inches. For the case of HTPB, the value of 0.0351 lb/in^3 was taken. In an actual solid fuel ramjet, $\dot{r}$ varies along the grain; $\dot{r}$ is largest in the region immediately downstream of the entrance port of the combustor. However, for the ramjet model developed here, the value of $\dot{r}$ is assumed to be constant along the grain. Consequently:

$$D_3 = D_{30} + 2\int_0^t \dot{r}\,dt \qquad (1.1.4)$$

The integral form for the change in grain internal diameter is used since $\dot{r}$ may vary with time. The initial grain inside diameter is D_{30} inches, and the inside area for fuel grain as a function of time can be written as:

$$A_3 = \frac{\pi}{4}\left[\sqrt{\frac{4}{\pi} A_{30}} + 2\int_0^t \dot{r}dt\right]^2 \qquad (1.1.5)$$

By definition, the fuel - air ratio is:

$$f = \frac{W_f}{W_a} \qquad (1.1.6)$$

The value for W_a is obtained from weight flow through the inlet, and the value for W_f is calculated using equation (1.1.3). The total mass flow through the nozzle is given by:

$$W_T = W_f + W_a = W_a(1 + f) \qquad (1.1.7)$$

For HTPB burning in air, the stoichiometric value for f is 0.0728; high combustion efficiency is difficult when f is less than 0.025.

A1.2 Computation of Combustion Exit Condition

Combustor exit conditions are specified by four quantities as follows: stagnation temperature, T_{T4}, 0_R; stagnation pressure, P_{T4}, psi; ratio of heat capacities, γ_f; and gas constant, R_f, in/0_R. In the computer program, the appropriate mks units are used, i.e. 0_K, kg/m^2, m/0_K, respectively. To determine the exit conditions, two input quantities are needed. These are fuel - air ratio and stagnation temperature at the combustor inlet, T_{T0}. Note that $T_{T3} = T_{T0}$ has been assumed.

From the thermodynamic data for HTPB burning in air, one determines $T_{T4}(th)$, γ_f, R_f. The symbol $T_{T4}(th)$ is a theoretical temperature which results from 100% combustion efficiency. Introducing the definition of combustion efficiency yields:

$$T_{T4} = \left[\eta_T \; T_{T4}(th) - T_{T0}\right] + T_{T0} \tag{1.2.1}$$

As discussed previously, a constant value of η_T equal to 0.9 has been assumed.

The value for p_{T4} is calculated based on one-dimensional, choked nozzle flow. A certain value of p_{T4} is required to force a certain weight flow, W_T, through the nozzle. Assume that γ_f remains fixed through the nozzle. Define a function of γ_f as:

$$\Gamma = \sqrt{\gamma_f}\left[\frac{2}{\gamma_f + 1}\right]^{(\gamma_f + 1)/[2(\gamma_f - 1)]} \tag{1.2.2}$$

Define a characteristic nozzle velocity,

c*, m/sec:

$$c^* = \frac{\sqrt{g \; R_f \; T_{T4}}}{\Gamma} \tag{1.2.3}$$

where g is the acceleration of gravity and has value of 9.807 m/sec^2. The required value for p_{T4} is given by:

$$p_{T4} = \frac{W_T c^*}{g A_5} \tag{1.2.4}$$

The decrease of flight stagnation pressure, p_{T0}, by inlet and combustor losses must not be too large. If the inlet and combustor do not provide the required p_{T4}, the inlet will unstart and W_a will decrease.

A1.3 Computation of Nozzle Exit Conditions

The relation between the area ratios and the Mach number is well known by the formula:

$$\frac{A_5}{A_6} = M_6 \left\{ \frac{(\gamma_f + 1)/2}{1 + \frac{\gamma_f - 1}{2} M_6^2} \right\}^{(\gamma_f + 1)/[2(\gamma_f - 1)]} \qquad (1.3.1)$$

A_5, A_6 are the areas at the throat and at the exit of the nozzle, respectively. Knowing γ_f, the exit Mach number (M_6) can be calculated for any nozzle area ratio (A_5/A_6). This indirect calculation is done in subroutine CALCM, using Newton - Raphson's iteration routine.
The total pressure at the exit of the nozzle (p_{T6}) is defined by:

$$p_{T6} = p_{T4} \quad \pi_n \qquad (1.3.2)$$

where the total pressure at the exit of the combustor (p_{T4}) was calculated previously (e.g. 1.2.4).

Knowing the total pressure at the exit of the nozzle (p_{T6}) and the Mach number at this point (M_6), the exit pressure (p_6) can be calculated:

$$p_6 = p_{T6} \left(1 + \frac{\gamma_f - 1}{2} M_6^2\right)^{-\gamma_f/(\gamma_f - 1)} \qquad (1.3.3)$$

A1.4 Computation of Thrust and Thrust Coefficient

A1.4.1 Thrust Coefficient (C_f)

The thrust of the engine is the net rate of change in momentum at a steady state condition, and is given by:

$$\begin{aligned} F &= p_6 A_6 + \dot{m}_6 U_0 - p_0 A_0 - \dot{m} U_0 - p_0 (A_4 - A_0) + p_0 (A_4 - A_6) \\ &= p_6 A_6 + \dot{m}_6 U_6 - p_0 A_6 - \dot{m}_0 U_0 \qquad (1.4.1) \end{aligned}$$

where U_0, U_6, $\dot{m}_0$, $\dot{m}_6$ are the velocities and mass flow at the inlet entrance and at the nozzle exit, respectively.

From the continuity equation, the following relation arrives:

$$\dot{m}U = \rho U^2 A \qquad (1.4.2)$$

Substituting for the density (ρ) from the perfect gas equation of state:

$$\rho = \frac{p}{RT} \qquad (1.4.3)$$

gives:

$$\dot{m}U = \frac{p}{RT} U^2 A \qquad (1.4.4)$$

From the definition of Mach number and speed of sound:

$$U^2 = M^2 a^2 \; ; \; a^2 = \gamma RT \quad (1.4.5)$$

Therefore:

$$\dot{m}U = \frac{p}{RT} M^2 \gamma RTA$$

$$\dot{m}U = pM^2 \gamma A \qquad (1.4.7)$$

Substituting (1.4.7) into (1.4.1) gives:

$$F = p_6 A_6 (1 + \gamma_f M_6^2) - p_0 A_0 (\frac{A_6}{A_0} + \gamma_a M_0^2) \qquad (1.4.8)$$

The thrust coefficient is defined :

$$C_f = \frac{F}{q_0 A_r} \qquad (1.4.9)$$

where:

$$q_0 = \tfrac{1}{2}\rho_0 U_0^2 = \tfrac{1}{2}\gamma_a p_0 M_0^2 \qquad (1.4.10)$$

Combining equation (1.4.9) and 1.4.10) gives:

$$C_f = \frac{F}{\frac{\gamma_a}{2} p_0 M_0^2 A_r} \qquad (1.4.11)$$

Substituting for the thrust from equation (1.4.8) turns equation (1.4.11) into:

$$C_f = \frac{2A_6/A_r}{\gamma_a M_0^2} \left[\frac{p_{T6}/p_0}{p_{T6}/p_6} (1 + \gamma_f M_6^2) - 1 \right] - \frac{2A_0}{A_r} \qquad (1.4.12)$$

A1.4.2 Pressure Losses

The pressure ratios in the above formula:

$$\frac{p_{T6}/p_{T0}}{p_{T6}/p_6}$$

can be substituted by a function of pressure losses across the ramjet:

$$\frac{p_{T6}}{p_0} = \frac{p_{T6}}{p_{T4}}\ \frac{p_{T4}}{p_{T3}}\ \frac{p_{T3}}{p_{T2}}\ \frac{p_{T2}}{p_{T0}}\ \frac{p_{T0}}{p_0} \qquad (1.4.13)$$

We define the pressure losses as follows:

$\frac{p_{T6}}{p_{T4}} = \pi_n$ = Nozzle losses

$\frac{p_{T4}}{p_{T3}} = \pi_h$ = Rayleigh flow losses

$\frac{p_{T3}}{p_{T2}} = \pi_e$ = Combustor expansion losses

$\frac{p_{T2}}{p_{T0}} = \pi_D$ = Inlet losses = (conical wave loss)*(boundary layer loss)*

(normal shock loss)(subsonic diffuser recovery) = $\pi_C \pi_D{}' \pi_{NS} \pi_D{}''$

Therefore:

$$\frac{p_{T6}}{p_0} = \pi_n\ \pi_h\ \pi_e\ \pi_C\ \pi_D{}'\ \pi_{NS}\ \pi_D{}''\ \frac{p_{T0}}{p_0} = \left[\begin{matrix}\Pi(\pi_i)\\ i = \text{losses}\end{matrix}\right]\frac{p_{T0}}{p_0} \qquad (1.4.14)$$

Finally, substituting for total pressure ratios (p_{T0}/p_0; p_{T6}/p_6) gives:

$$\frac{p_{T6}/p_0}{p_{T6}/p_6} = \left[\begin{matrix}\Pi(\pi_i)\\ i=\text{losses}\end{matrix}\right] \frac{\left[1 + \frac{\gamma_a - 1}{2} M_0{}^2\right]^{\gamma_a/(\gamma_a - 1)}}{\left[1 + \frac{\gamma_f - 1}{2} M_6{}^2\right]^{\gamma_f/(\gamma_f - 1)}} \qquad (1.4.15)$$

This relation can be used in equation (1.4.12) which calculates the thrust coefficient of the system.

A1.4.3 Computation of Thrust

The thrust can easily be calculated from the thrust coefficient, using eq. (1.4.9):

$$F = C_f \, q_0 \, A_r \qquad (1.4.9a)$$

The dimensions of F are Newtons (after multiplying eq. (1.4.9a) by the acceleration of gravity, g). The fuel specific impulse, I_{sp}, in N/kg/sec, is defined by:

$$I_{sp} = F/W_f \qquad (1.4.16)$$

The specific fuel consumption, SFC, in kg/hour/N is given by:

$$SFC = 3600/I_{sp} \qquad (1.4.17)$$

Ramjet performance is specified in terms of the performance parameters C_f, F, I_{sp} and SFC.

A2. Check for Choked Nozzle

The total pressure at the throat of the nozzle is given by:

$$p_{T5} = p_{T4} \sqrt{\pi_n} \qquad (2.1)$$

Again, p_{T4}, is the total pressure at the exit of the combustor, and is calculated by eq. (1.2.4). π_n is the nozzle loss. It follows that:

$$p_5 = p_{T5} \left(\frac{2}{\gamma_f + 1}\right)^{\gamma_f/(\gamma_f+1)} \qquad (2.2)$$

The pressure at the throat of the nozzle (p_5) should be equal or greater than the atmosperic pressure (p_0).

$$p_5 \geq p_0 \qquad (2.3)$$

When inequality (2.3) is satisfied, the nozzle is choked.

A3. Heat Losses at the Combustor

A3.1 Mach Number

a. Continuity

At the combustion chamber, fuel is added and the continuity equation is:

$$\rho_3 U_3 A_3 (1 + f/a) = \rho_4 U_4 A_4 \qquad (3.1.1)$$

where A_3 and A_4 refer to the entrance and to the exit of the combustor, respectively. By assuming that $A_3 = A_4$, the continuity equation (eq. 3.1.1) can be written as follows:

$$\frac{\rho_3}{\rho_4} (1 + f/a) = \frac{U_4}{U_3} \qquad (3.1.2)$$

Replacing the velocities (U_3 and U_4) by the appropriate Mach numbers (eq. 1.4.5), turns eq. (3.1.3) into:

$$\frac{\rho_3}{\rho_4}(1 + f/a) = \left(\frac{M_4}{M_3}\right)\sqrt{\frac{T_4 \gamma_f R_f}{T_3 \gamma_a R_a}} \qquad (3.1.3)$$

Where R_a, R_f are the gas constants of air and of the combustion products, respectively. Hence:

$$\left(\frac{M_3}{M_4}\right) = \left(\frac{\rho_4}{\rho_3}\right)\left(\frac{T_4}{T_3}\right)^{\frac{1}{2}}\left(\frac{\gamma_f R_f}{\gamma_a R_a}\right)\left(\frac{1}{1 + f/a}\right) \qquad (3.1.4)$$

b. Momentum

Applying the conservation law of momentum to the discussed problem:

$$p_3 + \rho_3 U_3^2 = p_4 + \rho_4 U_4^2 \qquad (3.1.5)$$

From the definition of Mach number (eq. 1.4.5) and the perfect gas equation of state (eq. 1.4.3):

$$\rho_i U_i^2 = \gamma_i p_i M_i^2 \qquad (3.1.6)$$

Substituting equation (3.1.6) in equation (3.1.5):

$$\frac{p_4}{p_3} = \frac{1 + \gamma_a M_3^2}{1 + \gamma_f M_4^2} \qquad (3.1.7)$$

Again, from the perfect gas equation of state:

$$\frac{p_4}{p_3} = \left(\frac{\rho_4}{\rho_3}\right)\left(\frac{T_4}{T_3}\right) \qquad (3.1.8)$$

Substitution of (3.1.8) into (3.1.7):

$$\left(\frac{\rho_4}{\rho_3}\right) = \left(\frac{T_3}{T_4}\right)\left(\frac{1 + \gamma_a M_3^2}{1 + \gamma_f M_4^2}\right) \qquad (3.1.9)$$

Substituting (eq. 3.1.9) turns equation (3.1.4) into:

$$\left(\frac{M_3}{M_4}\right)\left(\frac{T_4}{T_3}\right)^{\frac{1}{2}} = \left(\frac{1 + \gamma_a M_3^2}{1 + \gamma_f M_4^2}\right)\left(\frac{\gamma_f R_f}{\gamma_a R_a}\right)^{\frac{1}{2}}\left(\frac{1}{1 + f/a}\right) \qquad (3.1.10)$$

Replacing the temperatures T_3 and T_4 by the appropriate total temperatures:

$$T_i = T_{Ti} \Big/ \left(1 + \frac{\gamma_i - 1}{2} M_i^2\right)$$

and assuming that the change in total temperature up to the entrance of the combustor, is negligible ($T_{T0} = T_{T3}$), one obtains:

$$\left(\frac{M_3}{M_6}\right) \left(\frac{T_{T4}}{T_{T0}}\right)^{\frac{1}{2}} = \left(\frac{1 + \gamma_a M_3^2}{1 + \gamma_f M_4^2}\right) \left|\frac{1 + \frac{\gamma_f - 1}{2} M_4^2}{1 + \frac{\gamma_a - 1}{2} M_3^2}\right|^{\frac{1}{2}} \left(\frac{\gamma_f R_f}{\gamma_a R_a}\right)^{\frac{1}{2}} \left(\frac{1}{1 + f/a}\right) \tag{3.1.11}$$

c. Solution

The Mach number at the exit of the combustor (M_4) can be solved knowing the conditions at the throat of the nozzle:

$$\frac{A_5}{A_6} = M_4 \left\{\frac{(\gamma_f + 1)/2}{1 + \frac{\gamma_f - 1}{2} M_4^2}\right\}^{(\gamma_f+1)/[2(\gamma_f-1)]} \tag{3.1.12}$$

The computation is again indirect, using subroutine CALCM. Knowing M_4, Equation (3.1.11) is used to compute M_3. The solution is received by iteration. As first approximation, M_3 can be solved from the following equation:

$$\frac{1}{M_3} \left(1 + \gamma_a M_3^2\right) = B \tag{3.1.11a}$$

where:

$$B = \left(\frac{1 + \gamma_f M_4^2}{M_4}\right) \left(\frac{T_{T4}}{T_{T0}}\right)^{\frac{1}{2}} \left(\frac{\gamma_a R_a}{\gamma_f R_f}\right)^{\frac{1}{2}} (1 + f/a) \tag{3.1.13}$$

consequently:

$$M_{3N} = \frac{+B - \sqrt{B^2 - 4\gamma_a}}{2\gamma_a} \tag{3.1.14}$$

The subscript N shows that the computation was made from the nozzle

direction. Now, B is changed to be:

$$B = B\left\{\frac{1 + \frac{\gamma_a - 1}{2} M_3^2}{1 + \frac{\gamma_f - 1}{2} M_4^2}\right\}^{\frac{1}{2}} \tag{3.1.15}$$

This expression is consistent with equation (3.1.11). Substituting back into (eq. 3.1.14) gives an improved value for M_3. This procedure can be repeated several times, but it was found that even after two interations, the value received for M_{3N} is accurate enough, due to the small change in B resulting from (eq. 3.1.15).

A3.2. Total Pressure

By definition:

$$\frac{p_{Ti}}{p_i} = \left\{1 + \frac{\gamma_i - 1}{2} M_i^2\right\}^{\gamma_f/(\gamma_f - 1)} \tag{3.2.1}$$

Consequently:

$$\frac{p_{T3}}{p_{T4}} = \frac{p_3}{p_4}\left\{\frac{\left[1 + \frac{\gamma_a - 1}{2} M_3^2\right]^{\gamma_a/(\gamma_a + 1)}}{\left[1 + \frac{\gamma_f - 1}{2} M_4^2\right]^{\gamma_f/(\gamma_f + 1)}}\right\} \tag{3.2.2}$$

Substituting for (p_3/p_4) from equation (3.1.7) results:

$$p_{T3N} = p_{T4}\left\{\frac{1 + \gamma_f M_4^2}{1 + \gamma_a M_3^2}\right\}\left\{\frac{\left[1 + \frac{\gamma_a - 1}{2} M_3^2\right]^{\gamma_a/(\gamma_a + 1)}}{\left[1 + \frac{\gamma_f - 1}{2} M_4^2\right]^{\gamma_f/(\gamma_f + 1)}}\right\} \tag{3.2.3}$$

Where the subscript N was defined previously.

A4. Computation of Mach Number and of Total Pressure at the Various Stations of the Inlet

A4.1 Initial Conditions

In the previous sections (A1 - A3) the pressure conditions at the combustor and at the nozzle region were calculated. Here, the pressure conditions at the inlet will be calculated independently. Knowing the total pressure conditions at the various stations of the inlet will allow the check of whether the inlet can supply the amount of air needed by the combustor. As will be seen afterwards, this check will also allow to specify the location of the normal shock wave at the inlet.

Assuming that the static pressure (p_0), the static temperature (T_0) and the flight **Mach** number (M_0) are known from the trajectory part of the program, the total pressure and the total temperature can be calculated:

$$p_{T0} = p_0 \left[1 + \frac{\gamma_a - 1}{2} M_0^2\right]^{\gamma_a/(\gamma_a - 1)} \tag{4.1.1}$$

$$T_{T0} = T_0 \left[1 + \frac{\gamma_a - 1}{2} M_0^2\right] \tag{4.1.2}$$

The weight flow through the inlet is given by:

$$W_a = \rho_0 U_0 A_0 \left(\frac{A_c}{A_0}\right) \tag{4.1.3}$$

Usually, when flight Mach number is equal or greater than the inlet design Mach number, the value for A_c/A_0 is unity. But for flight Mach number less than design Mach number, A_c/A_0 becomes less than 1.0. A value of 0.9 was selected as a constant value for A_c/A_0. The additive drag due to $A_c/A_0 < 1$ was ignored.

A4.2 Conical Shock Wave Loss

In this section, the conical shock wave loss will be computed; the calculation results include the total pressure, Mach number and area behind the conical wave (p_{T1C}, M_{1C}, A_{1C}, respectively).

A4.2.1 Pressure

The pressure coefficient can be defined as follows:

$$C_p = \frac{p_{1C}-p_0}{\frac{\gamma_a}{2} \quad p_0 \quad M_0^2} \qquad (4.2.1)$$

For a cone, the pressure coefficient (C_p) can approximately be formulated as:

$$C_p = \left[0.083 + \frac{0.096}{M_0^2}\right]\left(\frac{\alpha}{10}\right)^{1.69} \qquad (4.2.2)$$

where α is the cone half angle. The difference in pressure on surface and behind shock wave is ignored in this model.

Knowing C_p, the pressure ratio (p_{1C}/p_0) can be calculated (4.2.1)

$$\frac{p_{1C}}{p_0} = 1 + C_p \frac{\gamma_a}{2} M_0^2 \qquad (4.2.1a)$$

The same pressure ratio, is also related to the Mach number, normal to the conical shock wave (M_n). Using (eq. 2.48a) in ref. [16], one can get:

$$\frac{p_{1C}}{p_0} = 1 + \frac{2\gamma_a}{\gamma_a+1} (M_n^2-1) \qquad (4.2.3)$$

Knowing (p_{1C}/p_0) from equation (4.2.1a), M_n can be calculated from equation (4.2.3) :

$$M_n = \left[1+\left(\frac{p_{1C}}{p_0} - 1\right) \frac{\gamma_a+1}{2\gamma_a}\right]^{\frac{1}{2}} \qquad (4.2.3a)$$

After computing the pressure ratio due to conical shock wave (equation 4.2.1a) and the Mach number normal to the cone (equation 4.2.3a), one can use equation (2.54) in reference [16] to compute the total pressure ratio at the conical shock wave:

$$\pi_C = \frac{p_{T1C}}{p_{T0}} = \left[1 + \frac{2\gamma_a}{\gamma_a+1}\left(M_n^{\,2}-1\right)\right]^{-1/(\gamma_a-1)} \left[\frac{(\gamma_a+1)\ M_n^{\,2}}{(\gamma_a-1)\ M_n^{\,2}+2}\right]^{\gamma_a/(\gamma_a-1)} \tag{4.2.4}$$

From equation (4.2.4) one obtains:

$$p_{T1C} = p_{T0}\ \pi_C \tag{4.2.4a}$$

A4.2.2 Mach Number Downstream of Conical Shock Wave

Using figures 4.1 and 4.2, the wave angle (β) can be defined as:

$$\beta = \arcsin\left(\frac{M_n}{M_0}\right) \tag{4.2.5}$$

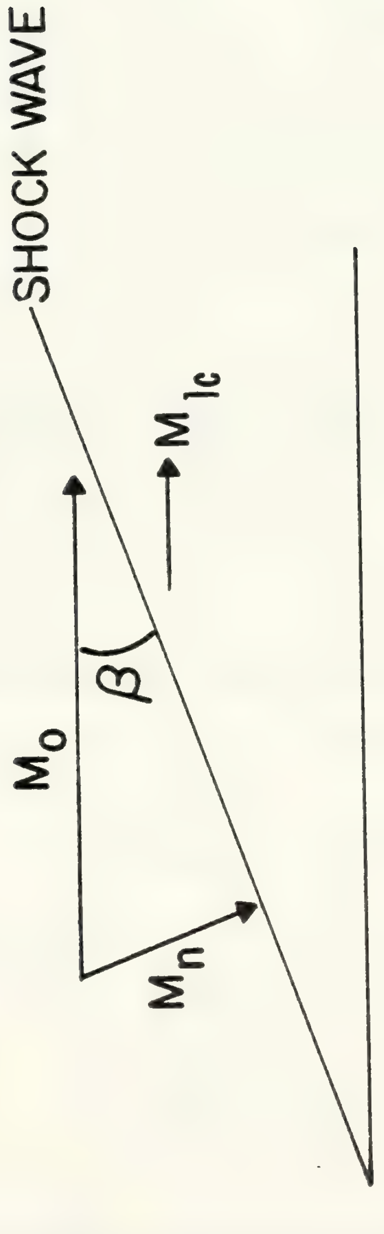
On the other hand, the deflection angle (θ) is defined from equation (4.10) in reference [16]:

$$\theta = \arctan\left[2\cot\,(\beta)\ \frac{(M_n^{\,2}-1)}{M_0^{\,2}\{\gamma_a+\cos(2\beta)\}+2}\right] \tag{4.2.6}$$

The Mach number behind the conical shock wave (M_{1C}) may, therefore, be obtained using equation (4.7) in reference [16]:

$$M_{1C} = \left[\frac{1}{\sin^2(\beta-\theta)}\ \frac{1+\frac{\gamma_a-1}{2}M_n^{\,2}}{\gamma_a M_n^{\,2} - \frac{\gamma_a-1}{2}}\right]^{\frac{1}{2}} \tag{4.2.7}$$

The relation between the deflection angle (θ) and the wave angle (β) for various Mach numbers are shown in figure 4.3 (reproduced from figure 4.2 in reference [16]).


SHOCK WAVE
M_o
β
M_{1c}
M_n

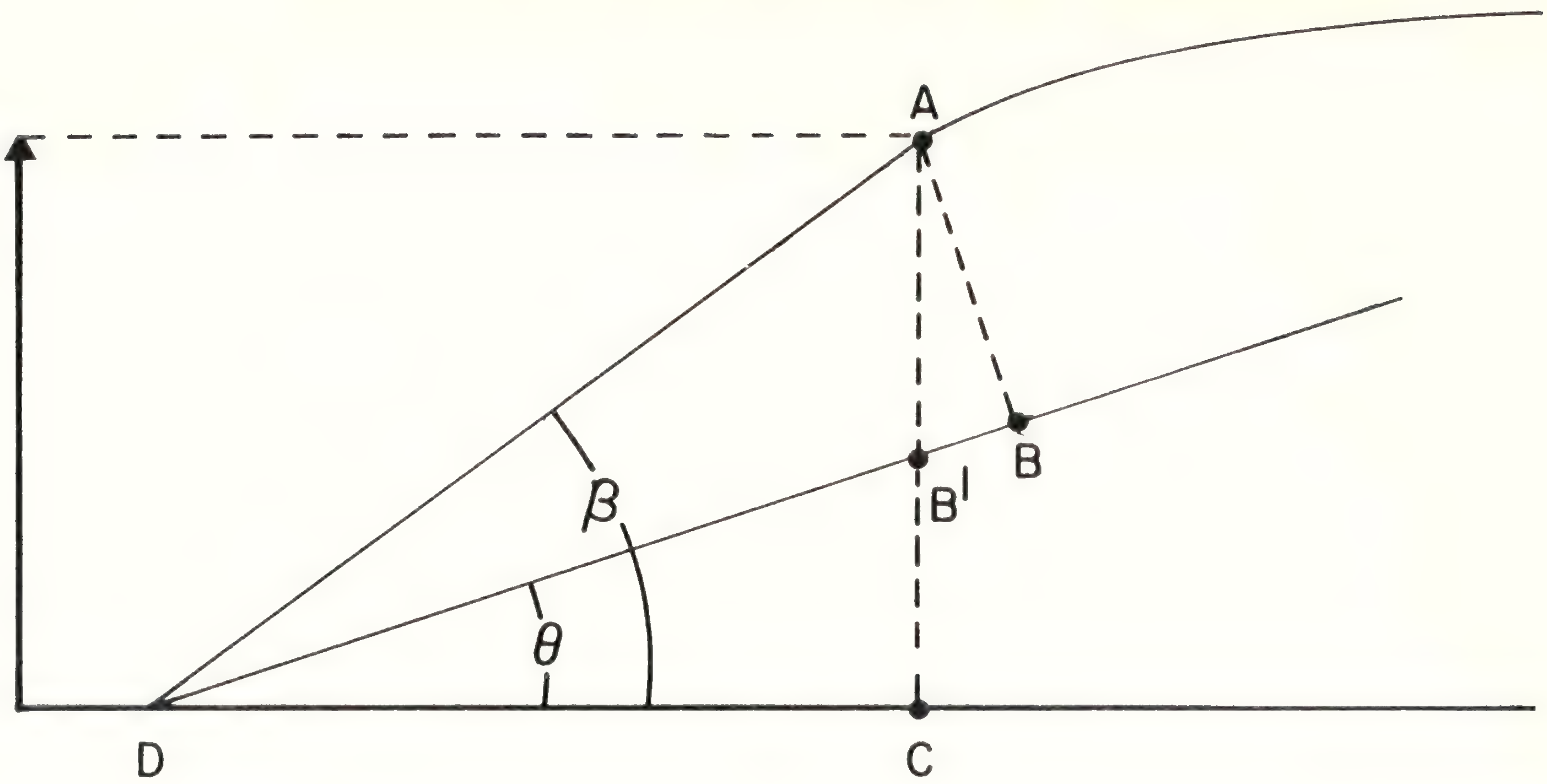


Figure A4.2 Geometry for Calculation of Inlet Annular Flow Area Relative to Inlet Capture Area:

$$DC = \frac{AC}{\tan\beta};\ B'C = \frac{AC}{\tan\beta}\tan\theta;\ AB' = AC\left(1 - \frac{\tan\theta}{\tan\beta}\right);\ \frac{AB}{AC} = \left(1 - \frac{\tan\theta}{\tan\beta}\right)\cos\theta$$

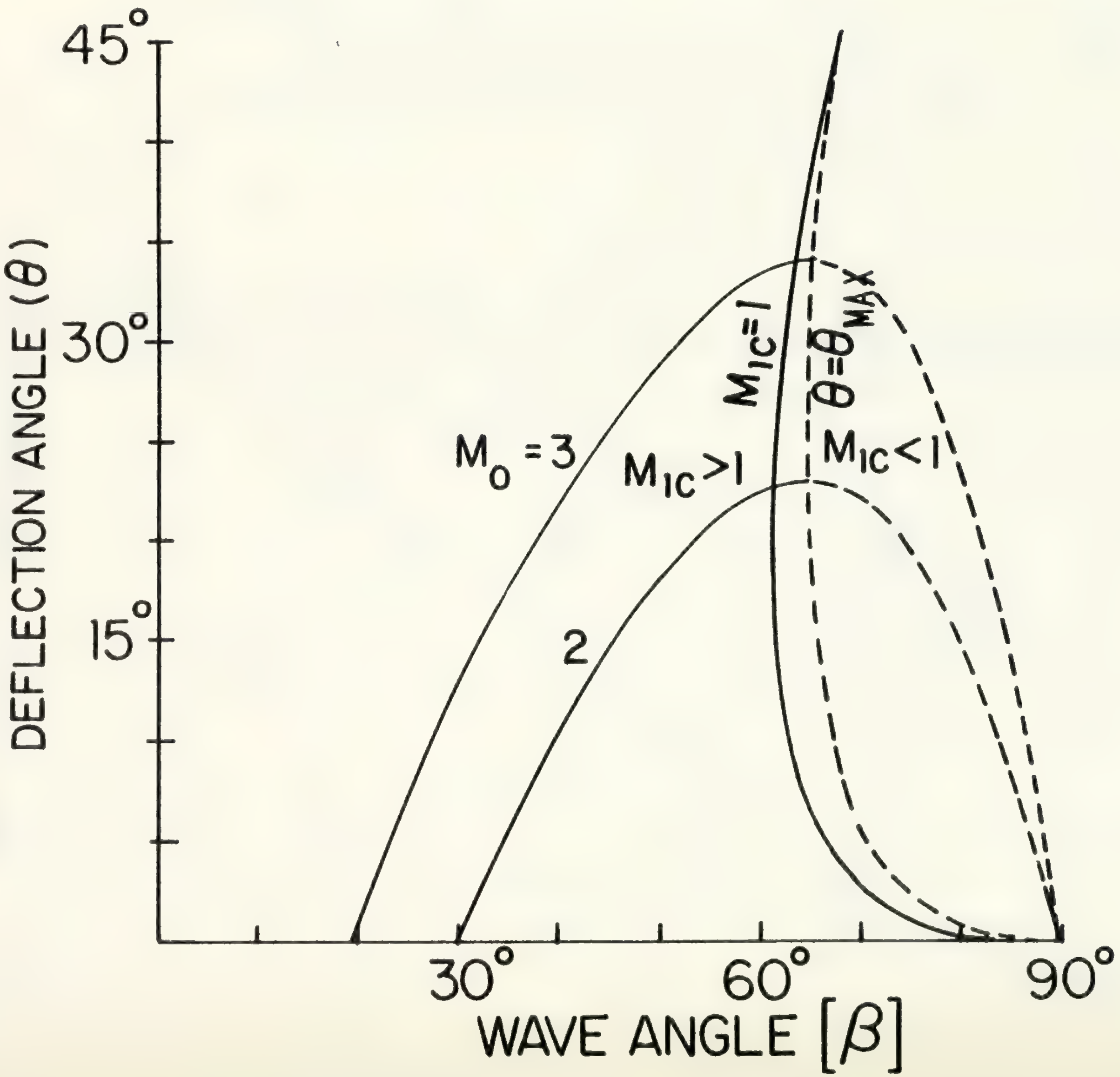


Figure A4.3 Oblique Shock Solutions [16]

A4.2.3 Area Ratio

Using figure 4.2, the area ratio behind the conical shock wave can be obtained:

$$\frac{A_{1C}}{A_0} = \frac{1-\tan(\theta)}{\tan(\beta)} \quad \cos(\theta) \tag{4.2.8}$$

Equation (4.2.8) gives the area normal to the flow at the inlet lip.

A4.3 Boundary Layer Loss

A4.3.1 Mach Number

The area ratio is related to the appropriate Mach number by by the formula:

$$\frac{A_1^*}{A_{1C}} = M_{1C} \left\{ \frac{(\gamma_a+1)/2}{1+\frac{\gamma_a-1}{2} M_{1C}^2} \right\}^{(\gamma_a+1)/[2(\gamma_a-1)]} \tag{4.3.1}$$

Where A_1^* is the area at the throat of the inlet. Similarly,

$$\frac{A_1^*}{A_{11}} = M_{11} \left\{ \frac{(\gamma_a+1)/2}{1+\frac{\gamma_a-1}{2} M_{11}^2} \right\}^{(\gamma_a+1)/[2(\gamma_a-1)]} \tag{4.3.2}$$

Where A_{11} and M_{11} relates to the area and to the Mach number ahead of the normal shock wave. Dividing these two equations gives:

$$\frac{A_{11}}{A_{1C}} = \frac{M_{1C}}{M_{11}} \left\{ \frac{1+\frac{\gamma_a-1}{2} M_{11}^2}{1+\frac{\gamma_a-1}{2} M_{1C}^2} \right\}^{(\gamma_a+1)/[2(\gamma_a-1)]} \tag{4.3.3}$$

Knowing M_{1C}, γ_a, A_{1C}, A_{11}, equation (4.3.3) can be used to calculate M_{11}, indirectly, by subroutine CALM, which was mentioned previously. M_{11} should be supersonic ($M_{11} > 1$) to prevent unstart conditions.

A4.3.2 Pressure

The total pressure in front of the normal shock wave (p_{T11}) is received from the connection:

$$p_{T11} = p_{T1C}\,\pi_D' \qquad (4.3.4)$$

Where π_D', the boundary layer loss is assumed to be 0.93.

A4.4 Normal Shock Loss

The Mach number, behind the normal shock wave is defined as:

$$M_{12} = \left\{\frac{M_{11}^2 + \frac{2}{\gamma_a - 1}}{\frac{2\gamma_a}{\gamma_a - 1} M_{11}^2 - 1}\right\}^{\frac{1}{2}} \qquad (4.4.1)$$

The total pressure behind the normal shock wave is defined as:

$$p_{T12} = p_{T11}\left\{\frac{\frac{\gamma_a+1}{2} M_{11}^2}{1 + \frac{\gamma_a+1}{2} M_{11}^2}\right\}^{\gamma_a/(\gamma_a-1)} \Bigg/ \left\{\frac{2\gamma_a}{\gamma_a+1} M_{11}^2 - \frac{\gamma_a-1}{\gamma_a+1}\right\}^{1/(\gamma_a-1)} \qquad (4.4.2)$$

A4.5 Subsonic Diffuser Recovery

Similar to equation (4.3.3) one can obtain:

$$\frac{A_2}{A_{12}} = \frac{M_{12}}{M_2}\left\{\frac{1 + \frac{\gamma_a-1}{2} M_2^2}{1 + \frac{\gamma_a-1}{2} M_{12}^2}\right\}^{(\gamma_a+1)/[2(\gamma_a-1)]} \qquad (4.5.1)$$

Knowing M_{11}, γ_a, A_{12}, and A_2, the Mach number at the exit of the inlet can be computed using subroutine CALCM. The total pressure at this station is defined as:

$$p_{T2} = p_{T12}\,\pi_D'' \qquad (4.5.2)$$

Where the subsonic diffuser recovery (π_D'') is assumed to be 0.93.

A4.6 Expansion Loss

A4.6.1 Mach Number

On their way to the combustor, the gases coming from the inlet expand at station 3; a sudden change in area from A_2 to A_3 occurs. The sudden change in area acts as a flameholder by creating a hot recirculation region. In this section, the loss in total pressure due to this expansion is calculated.

From the continuity equation:

$$\rho_2 U_2 A_2 = \rho_3 U_3 A_3 \tag{1.4.2a}$$

From perfect gas equation of state:

$$\rho = \frac{p}{RT} \tag{1.4.3}$$

and from the definition of Mach number and speed of sound:

$$M = U/a; \qquad a = \sqrt{\gamma RT} \tag{1.4.5}$$

Equation (1.4.2a) turns, therefore, into the form:

$$\frac{p_2}{RT_2} M_2 \sqrt{\gamma_a RT_2} \; A_2 = \frac{p_3}{RT_3} M_3 \sqrt{\gamma_a RT_3} \; A_3 \tag{4.6.1}$$

For sudden expansion of an incompressible fluid, the change in static pressure going from small area A_2 to large area A_3 is given by [16, 25]:

$$\frac{p_3 - p_2}{q_2} = 2A_{23}(1-A_{23}) \tag{4.6.2}$$

Where $A_{23} = A_2/A_3$. Also, for the incompressible case, the stagnation pressure ratio is given by [16, 25]:

$$\frac{p_{T3}}{p_{T2}} = 1 - \frac{q_2/p_2}{1+q_2/p_2}(1 - A_{23})^2 \tag{4.6.3}$$

According to equation (4.6.3) as M_2 decreases p_{T3} approaches p_{T2}. The model for sudden expansion with compressible flow is much more complicated.

It was assumed that static pressure is constant in the expansion. This assumption, which is reasonable for low values of M_2, is a conservative one, i.e. p_{T3}/p_{T2} is lower.

Substituting: $T_2/T_3 = \left[1 + \frac{\gamma_a - 1}{2} M_3^2\right] \Big/ \left[1 + \frac{\gamma_a - 1}{2} M_2^2\right]$

and $p_2 = p_3$, turns equation (4.6.1) to:

$$\frac{A_2}{A_3} = \frac{M_3}{M_2} \sqrt{\frac{1 + \frac{\gamma_a - 1}{2} M_3^2}{1 + \frac{\gamma_a - 1}{2} M_2^2}} \tag{4.6.4}$$

Solving equation (4.6.4) for M_3:

$$M_{3I} = \sqrt{\frac{\sqrt{1 + 4\alpha\beta} - 1}{2\alpha}} \tag{4.6.5}$$

Where:

$$\alpha = \frac{\gamma_a - 1}{2} \quad ; \qquad \beta = \frac{A_2 M_2^2}{A_3} (1 + \alpha M_2^2) \tag{4.6.6}$$

The subscript I shows that the computation was made from the inlet direction.

A4.6.2 Pressure

By assuming again that $p_2 = p_3$,

$$\frac{p_{T3}}{p_{T2}} = \frac{p_{T3}/p_3}{p_{T2}/p_2} \tag{4.6.7}$$

and therefore:

$$p_{T3I} = p_{T2} \left(\frac{1 + \frac{\gamma_a - 1}{2} M_3^2}{1 + \frac{\gamma_a - 1}{2} M_2^2} \right)^{\gamma_a/(\gamma_a - 1)} \tag{4.6.8}$$

Where subscript I is as defined previously.

A4.7 Location of Normal Shock Wave

The main problem in computing the Mach numbers and the total pressures at the inlet arises from the fact that the exact location of the normal shock wave is not known, and must be found. The way of solving this problem is as follows:

First, solve for two extreme conditions by assuming that the normal shock wave is located at the throat and at the exit of the inlet, respectively. After knowing the lower and the upper values for M_{3I}, p_{T3I}, iteration can be made to find the exact location of the normal shock wave. The criteria for this iteration is matching of values for M_3, p_{T3} from both the inlet and the nozzle directions, i.e.:

$$M_{3I} = M_{3N}, \quad p_{T3I} = p_{T3N} \tag{4.7.1}$$

APPENDIX B: TRAJECTORY EQUATIONS

B1. Atmospheric Functions

Best fit curves were calculated for basic atmospheric functions, pressure, density, temperature and viscosity of air as a function of the flight altitude. The basic formula which was used for this process is as follows:

$$F = A \exp(-B \times 10^{-6} h^{C}) \tag{1.1}$$

Where h is the altitude in meters, and A,B,C are numerical parameters. The appropriate atmospheric functions are as follows:

$$p_0 = 1.03322 \times 10^{4} \exp(-59.148 \times 10^{-6} h^{1.09}) \tag{1.2}$$

$$\rho_0 = 1.224845 \exp(-29.0144 \times 10^{-6} h^{1.15}) \tag{1.3}$$

$$T_0 = 288.16 \exp(-13.232 \times 10^{-6} h^{1.0709})$$

When: $h = 0 - 11{,}000\text{m}$ (1.4)

$$T_0 = 217.24°, \text{ when } h = 11{,}000\text{-}32{,}000\text{m} \tag{1.4a}$$

$$\mu_0 = 1.793 \times 10^{-5} \exp(-45.1374 \times 10^{-6} h^{0.8984})$$

When: $h = 0\text{-}11{,}000\text{m}$ (1.5)

$$\mu_0 = 1.41724 \times 10^{-5}, \text{ when } h \geq 11{,}000 \text{ m} \tag{1.5a}$$

In these formulae, the pressure (p_0) has dimensions of kg/m^2, the density (ρ_0) is given in kg/m^3, the temperature (T_0) is given in 0_K, and the viscosity (μ_0) is given in $kg/(m \cdot sec)$ (or: $N \cdot sec/m^2$).

B2. Drag

B2.1 Cowl Drag Coefficient

2.1.1 It was found that the cowl drag coefficient has a strong influence on the results. Therefore, a new model for this cowl drag coefficient was developed. The model was based on a theoretical development done previously by Prof. T. H. Gawain [9]. The main

difference between this development and the classical theory, is that the boundary conditions are applied at the body surface rather than along the axis.

2.1.2 The model, which originally was developed for simple cases (cones, etc.), was modified to fit the shape of the projectile, illustrated in Figure 1.1.

2.1.3 The modified program is listed in Appendix G. In the combined program (TRAJET) an interpulation procedure was used as a subroutine in order to simplify the calculation process.

B2.2 Base Drag

After checking the influence of the nozzle exit area (A_6) on the performance, it was decided to allow A_6 to reach the maximum value possible (A_r), in order to reduce base drag. In this case, the base drag is negligible.

B2.3 Skin Drag Coefficient

The Reynolds number is well known to be:

$$Re_L = \frac{\rho_0 U_0 L}{\mu} \qquad (2.3.1)$$

The transition Reynolds number of

$$Re^* = 2 * 10^6$$

is usually taken as criterion for transition between laminar flow (lower values) and turbulent flow (higher values). The incompressible laminar skin friction coefficient is related to the Reynolds number as follows:

$$C_{DS,L} = 1.328/\sqrt{Re_L} \qquad (2.3.2)$$

Where the subscripts DS,L stand for skin drag coefficient, and laminar flow, respectively. On the other hand, the turbulent skin friction coefficient ($C_{DS,T}$) is calculated indirectly from the formula:

$$\sqrt{C_{DS,T}} \quad \log_{10}(C_{DS,T}\, Re_L) = 0.242 \tag{2.3.3}$$

The computation is done in subroutine CALDC, which works in a similar way to subroutine CALCM which has been described earlier concerning the calculation of various Mach numbers.

B2.4 Wing and Fin Drag Coefficients

The wings and the fins of the projectile, also contribute to drag. Basically, each of these drag coefficients contains two parts:

-Wing/fin wave drag.
-Wing/fin friction drag.

2.4.1 A psuedo 3-dimensional model was chosen to simulate the wave coefficient. The basic formulae used in this calculation are:

$$\nu(M_0) = \sqrt{\frac{\gamma_a+1}{\gamma_a-1}} \tan^{-1}\sqrt{\frac{\gamma_a-1}{\gamma_a+1}(M_0{}^2-1)} - \tan^{-1}\sqrt{M_0{}^2-1} \tag{2.4.1}$$

$$p_0/p_{T0} = \left(1 + \frac{\gamma_a+1}{2} M_0{}^2\right)^{-\gamma_a/(\gamma_a+1)} \tag{2.4.2}$$

The effective span could be taken as (see fig. B2.1):

$$b' = b - \frac{\ell}{2} \tag{2.4.3}$$

Substituting: $\tan\mu = \ell/c$, $\sin\mu = 1/M$ gives:

$$b' = b - \frac{c}{2\sqrt{M_0{}^2-1}} \tag{2.4.4}$$

The drag coefficient would, therefore, be:

$$C_{DWW} = \frac{2}{\gamma M_0{}^2}\left(\frac{p_{01}/p_{T0}}{p_0/p_{T0}} - \frac{p_{02}/p_{T0}}{p_0/p_{T0}}\right)\frac{tb'}{A_r} \tag{2.4.5}$$

The way this simulation uses the above equations could easily be understood when looking at the formulae together with the flow chart of the appropriate subroutine (Appendix C). Interference drag is ignored.

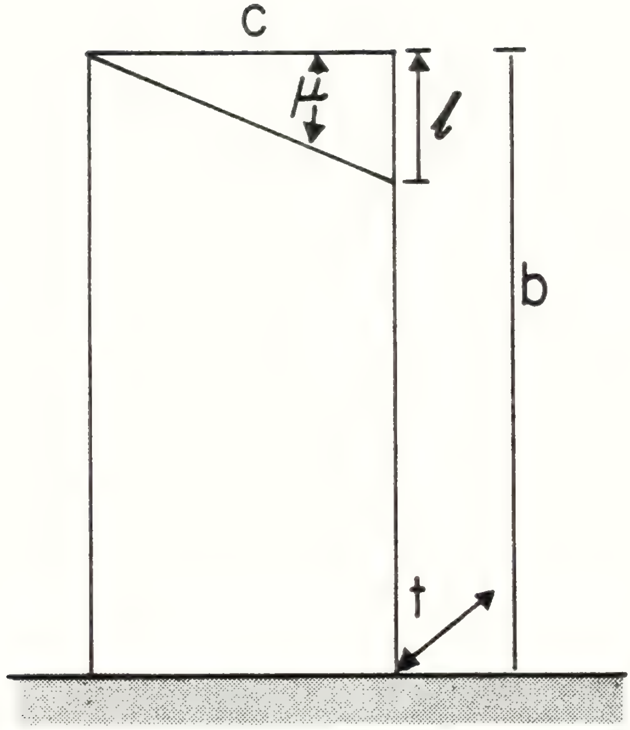


Figure B2.1 Schematic View of an Wing/Fin:
b=span, c=chord, t=thickness

2.4.2 The friction drag coefficient was calculated using the existing model for skin drag coefficient. (See Section B2.3)

B2.5 Calculation of Drag

Define the dynamic pressure (9) as follows:

$$q = \tfrac{1}{2}\rho_0 U_0^2 \qquad (2.5.1)$$

When q is in units of kg/(m.sec^2), (or: N/m^2). Also, define the following geometrical units:

$$A_p = \pi R^2; \qquad S_p = 2\pi RL \qquad (2.5.2)$$

Where R,L are the radius and the length of the projectile, respectively. Similiarly, for the wings or the fins:

$$S_{WW} = nbc \qquad (2.5.3)$$

Where n is the total number of wings/fins (a value of 8 was taken for n), and b,c are the span and the chord of the wing/fin (see fig. B2.1) Consequently, the drag (D) is given by:

$$D = q\left\{A_p\, C_{DN} + S_p\, C_{DS} + S_{WW}\,(C_{DWW} + C_{DWF})\right\} \qquad (2.5.4)$$

B2.6 Drag Coefficient of a Conventional Projectile Without Propulsion

The program has an option to calculate also the trajectory of a projectile without a propulsion. The projectile is a conventional round. The formulae used to claculate the drag coefficients in this case are:

2.6.1 Nose Drag

$$C_{DN} = (0.083 + 0.096/M_0^2)(\alpha/10)^{1.69}$$

Where α is the cone half angle.

2.6.2 Base Drag

$$C_{DB} = (0.6837 - 0.3165\,M + 0.0525\,M^2)(2/\pi)$$

2.6.3 Skin Drag

Skin drag is calculated as discussed in section B2.3.

2.6.4 Drag

$$D = \text{Drag} = q \left\{ A_p \, (C_{DN} + C_{DB}) + S_p \, C_{DS} \right\}$$

B3. Booster

The projectile has an initial muzzle velocity of 2500 ft/sec. Part of the combustor volume can be used as a booster to accelerate the projectile even more so that starting the ramjet will be easier.

Define exhaust velocity (U_e) as:

$$U_e = I_{sp,B} \, g \tag{3.1}$$

Where $I_{sp,B}$ is the specific impulse of the booster's fuel (in sec) and g is the acceleration of gravity (in m/sec).

From Newton's law [6, p. 323]

$$F = \dot{m}_B \, U_e = (m_p - \dot{m}_B t) \, \frac{dU}{dt} \tag{3.2}$$

Where m_p and $\dot{m}_B$ are the mass of the projectile and the mass flow of the booster respectively.

$$dU = \dot{m}_B \, U_e \, \frac{dt}{m_p - \dot{m}_B t} \tag{3.3}$$

Consequently:

$$\Delta U = U(\tau) - U(0) = -U_e \ln \frac{m_p - \dot{m}_B \tau}{m_p} \tag{3.4}$$

Where τ is the booster burn time. Hence,

$$\Delta U = U_e \quad \frac{m_p}{m_p - m_B} \tag{3.5}$$

ΔU is the change in initial velocity due to the booster, where m_B is the mass of the booster.

B4. Dynamics

The flat earth trajectory with drag and thrust is well known. The differential equations of motion are:

$$\frac{d^2y}{dt^2} = -g + (F-D)\sin\theta/m_p \tag{4.1}$$

$$m_p\frac{d^2x}{dt^2} = (F-D)\cos\theta \tag{4.2}$$

where y is the altitude, t is the time, g is the acceleration of gravity, F is the thrust, D is the drag, θ is the elevation angle, m_p is the projectile mass.

For numerical solution of equations (4.1) and (4.2) a finite difference form can be used as follows:

$$x_{j+2} = (F-D)\cos\theta\,\Delta t^2/m_p + 2x_{j+1} - x_j \tag{4.3}$$

$$y_{j+2} = [-g + (F-D)\sin\theta/m_p]\,\Delta t^2 + 2y_{j+1} - y_j \tag{4.4}$$

The values for j = 1 are from initial conditions, i.e.

$$x_1 = o,\ y_1 = 0 \tag{4.5}$$

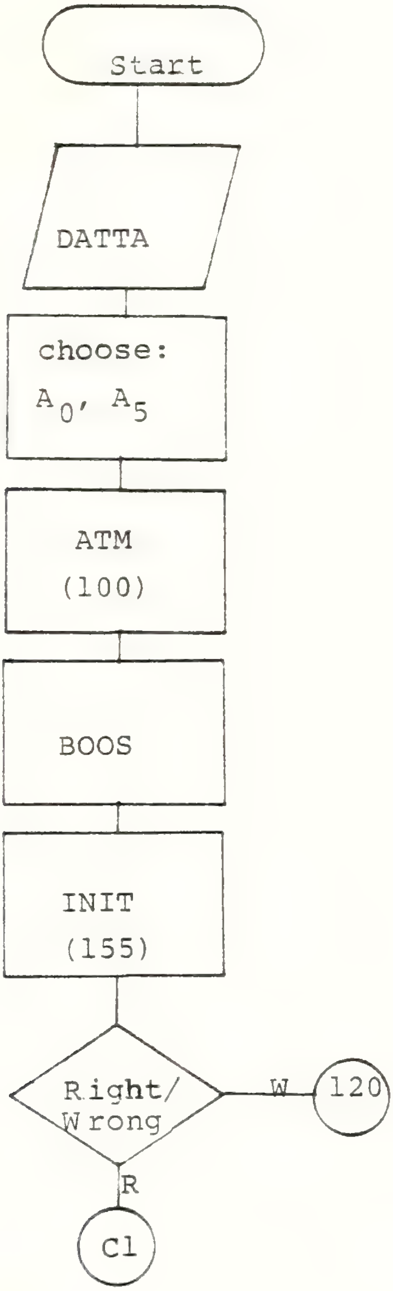
$$x_2 = U_0 * \cos\theta * \Delta t,\ y_2 = U_0 * \sin\theta * \Delta t \tag{4.6}$$

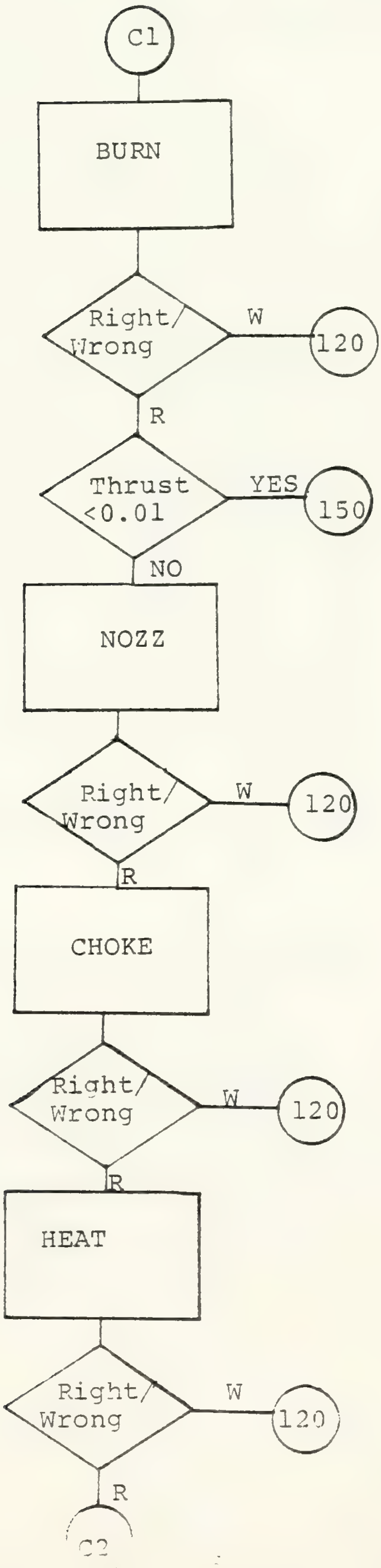
$$\theta = \arctan\left[\frac{y_{j+2} - y_{j+1}}{x_{j+2} - x_{j+1}}\right] \tag{4.7}$$

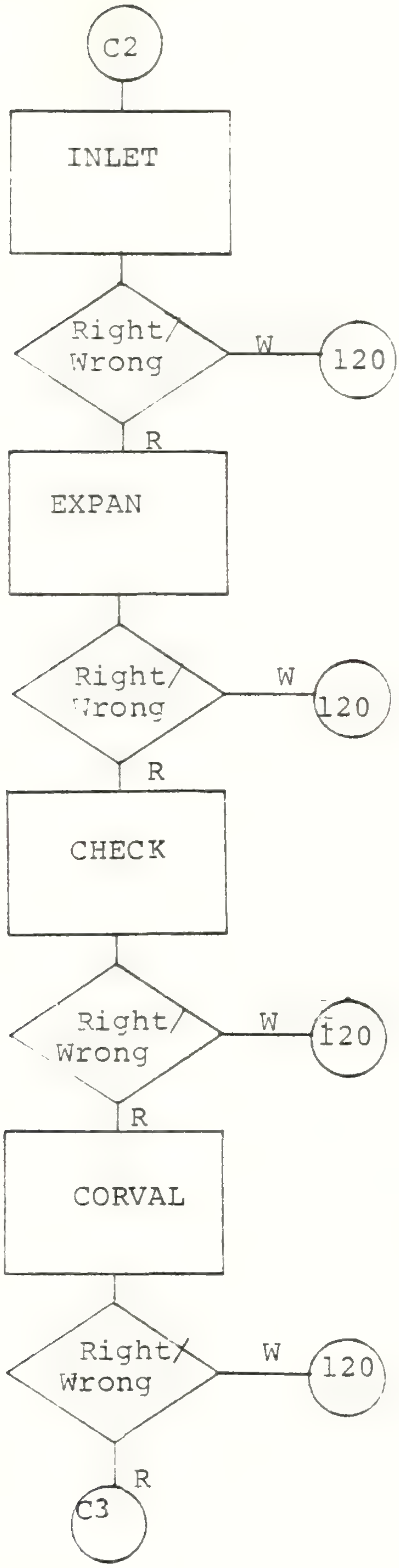
Having calculated x_{j+2} and y_{j+2} from (eq. 4.3, and 4.4), one obtained new values for trajectory parameters using (eq. 4.7). Also thrust, drag and projectile mass are updated for j+2.

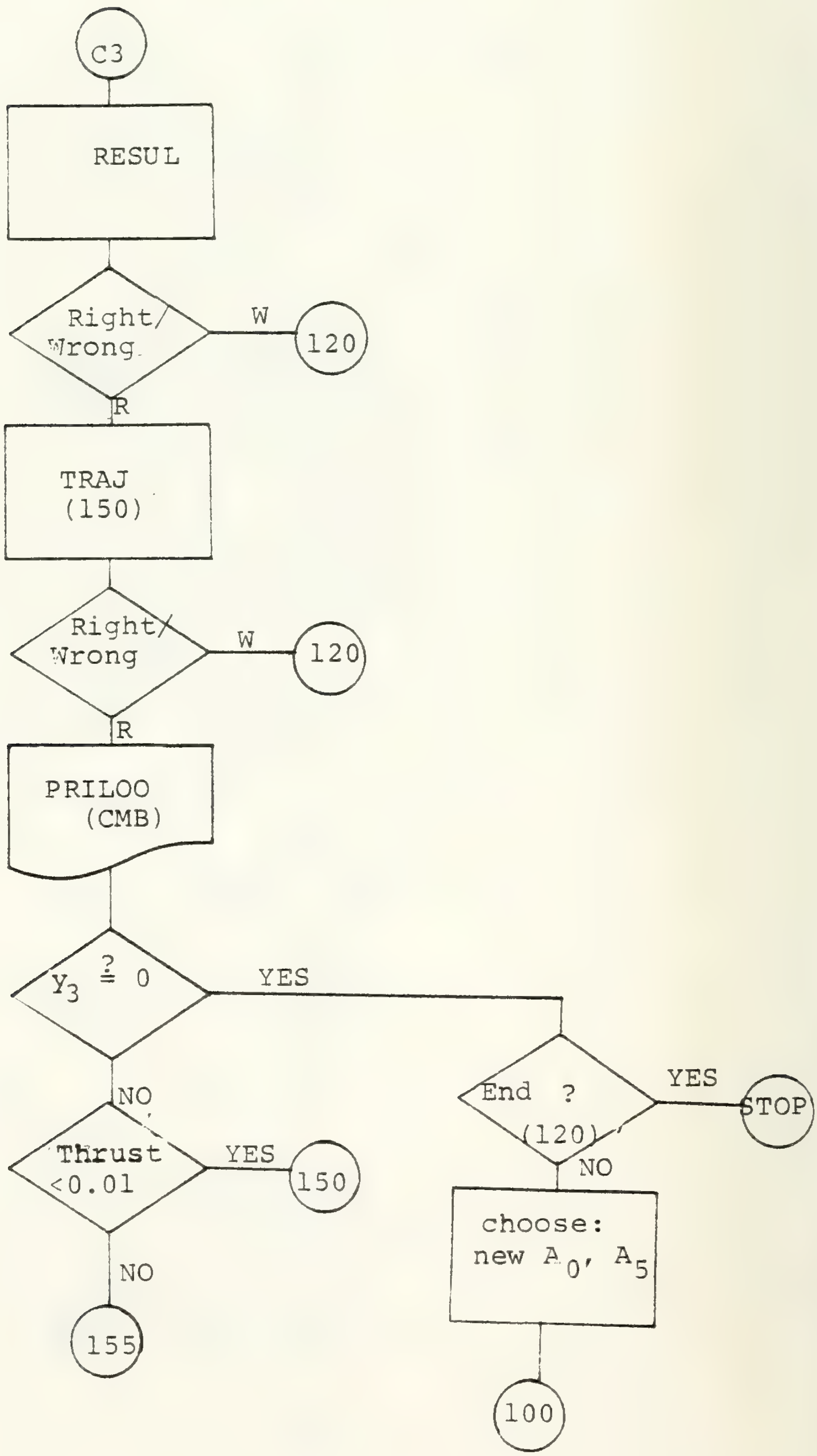
Appendix C: Flow Chart of the Computer Program (TRAJET)

C 1. Main Program

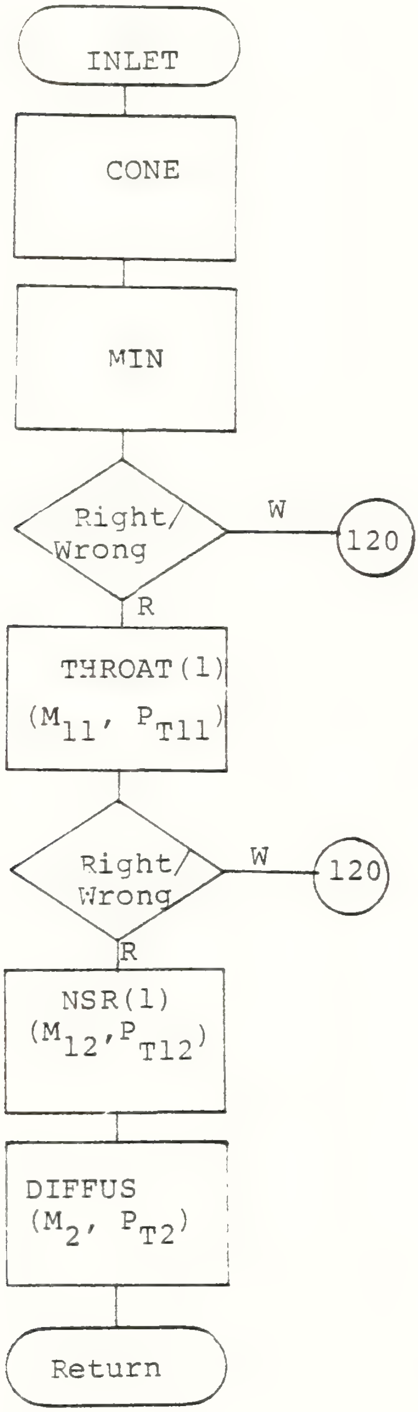


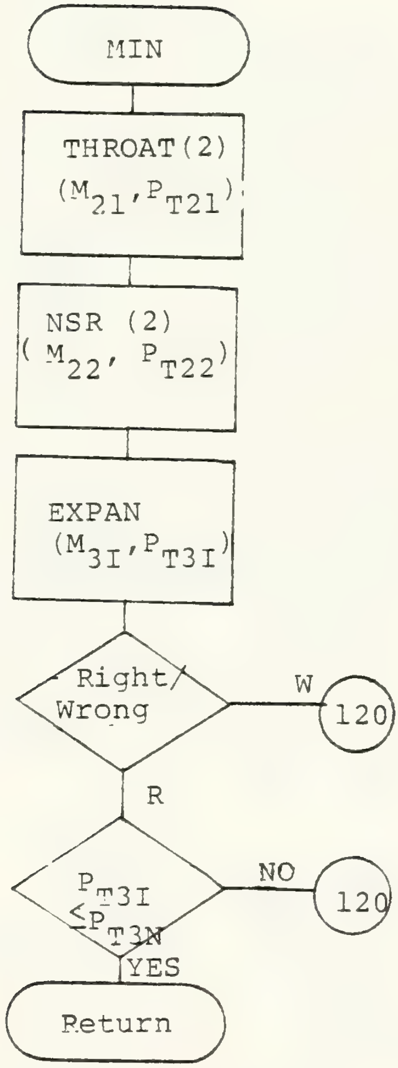

C1
BURN
Right/
Wrong
W
120
R
Thrust
<0.01
YES
150
NO
NOZZ
Right/
Wrong
W
120
R
CHOKE
Right/
Wrong
W
120
R
HEAT
Right/
Wrong
W
120
R
C2

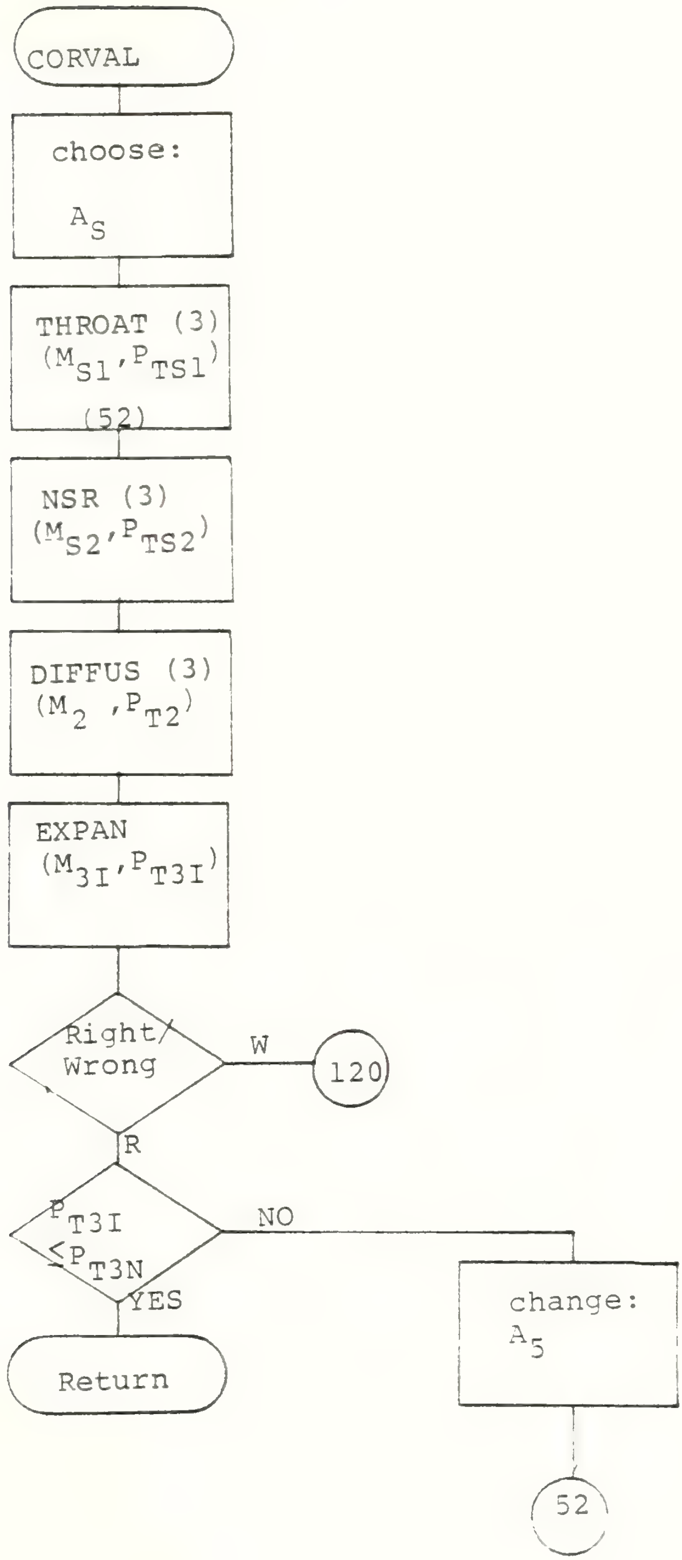

C2
INLET
Right/
Wrong
W
120
R
EXPAN
Right/
Wrong
W
120
R
CHECK
Right/
Wrong
W
120
R
CORVAL
Right/
Wrong
W
120
R
C3

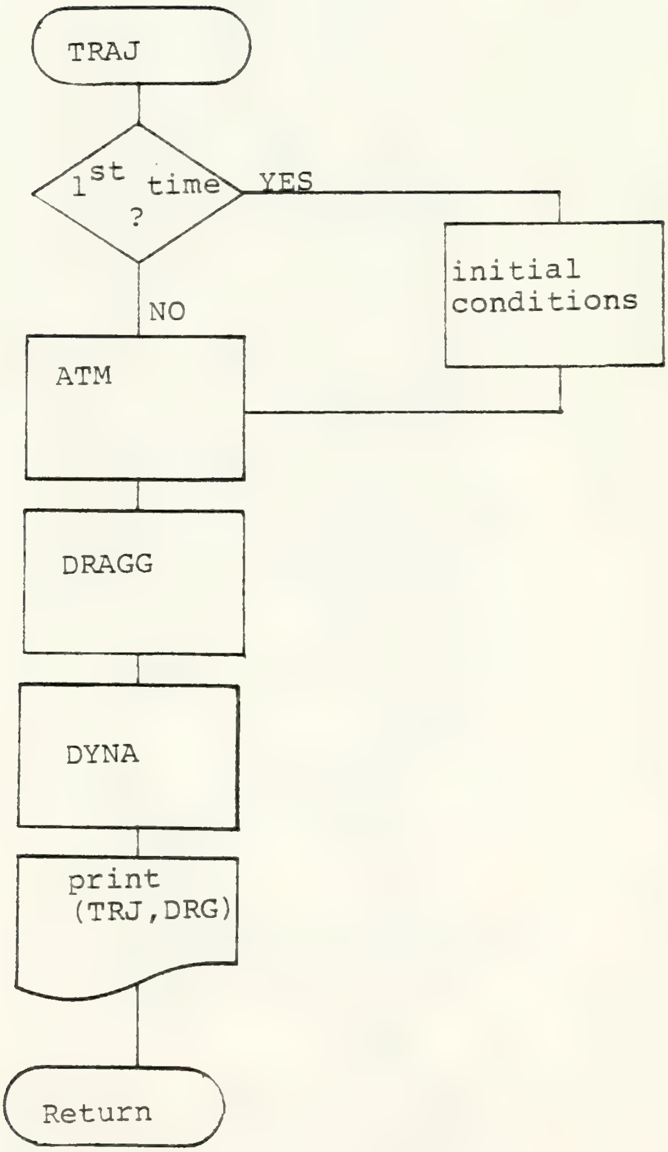

C3
RESUL
Right/
Wrong
W
120
R
TRAJ
(150)
Right/
Wrong
W
120
R
PRILOO
(CMB)
$Y_3 \stackrel{?}{=} 0$
YES
NO
Thrust
<0.01
YES
150
NO
155
End ?
(120)
YES
STOP
NO
choose:
new A_0, A_5
100

C2. Command Subroutines

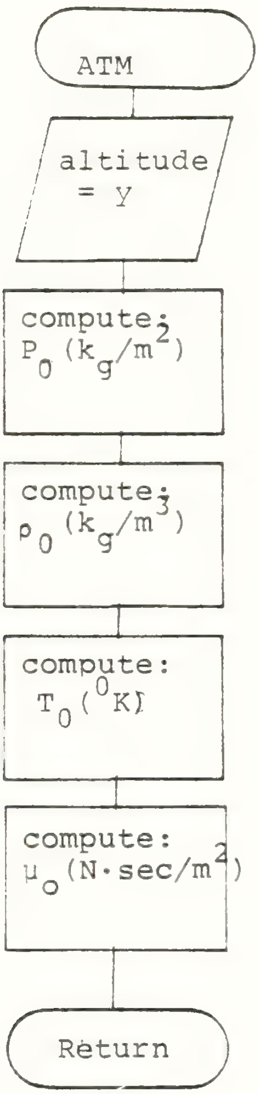


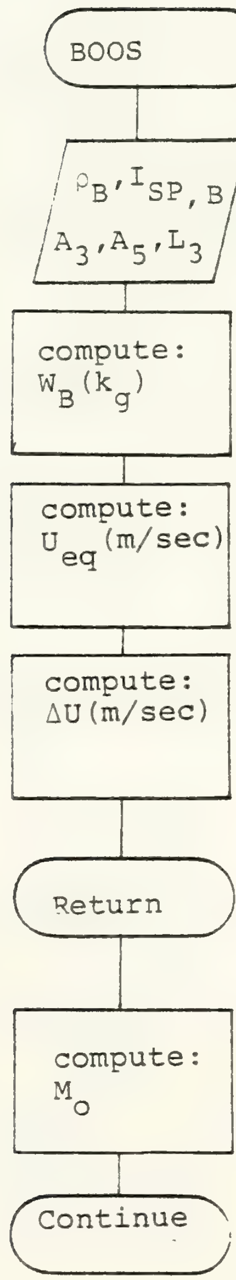

MIN
THROAT(2)
(M_{21}, P_{T21})
NSR (2)
(M_{22}, P_{T22})
EXPAN
(M_{3I}, P_{T3I})
Right/
Wrong
W
120
R
P_{T3I}
$\leq P_{T3N}$
NO
120
YES
Return

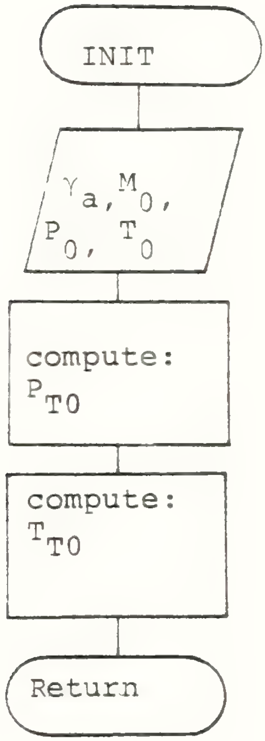

CORVAL
choose:
A_S
THROAT (3)
(M_{S1}, P_{TS1})
(52)
NSR (3)
(M_{S2}, P_{TS2})
DIFFUS (3)
(M_2, P_{T2})
EXPAN
(M_{3I}, P_{T3I})
Right/
Wrong
W
120
R
P_{T3I}
$\leq P_{T3N}$
NO
YES
Return
change:
A_5
52

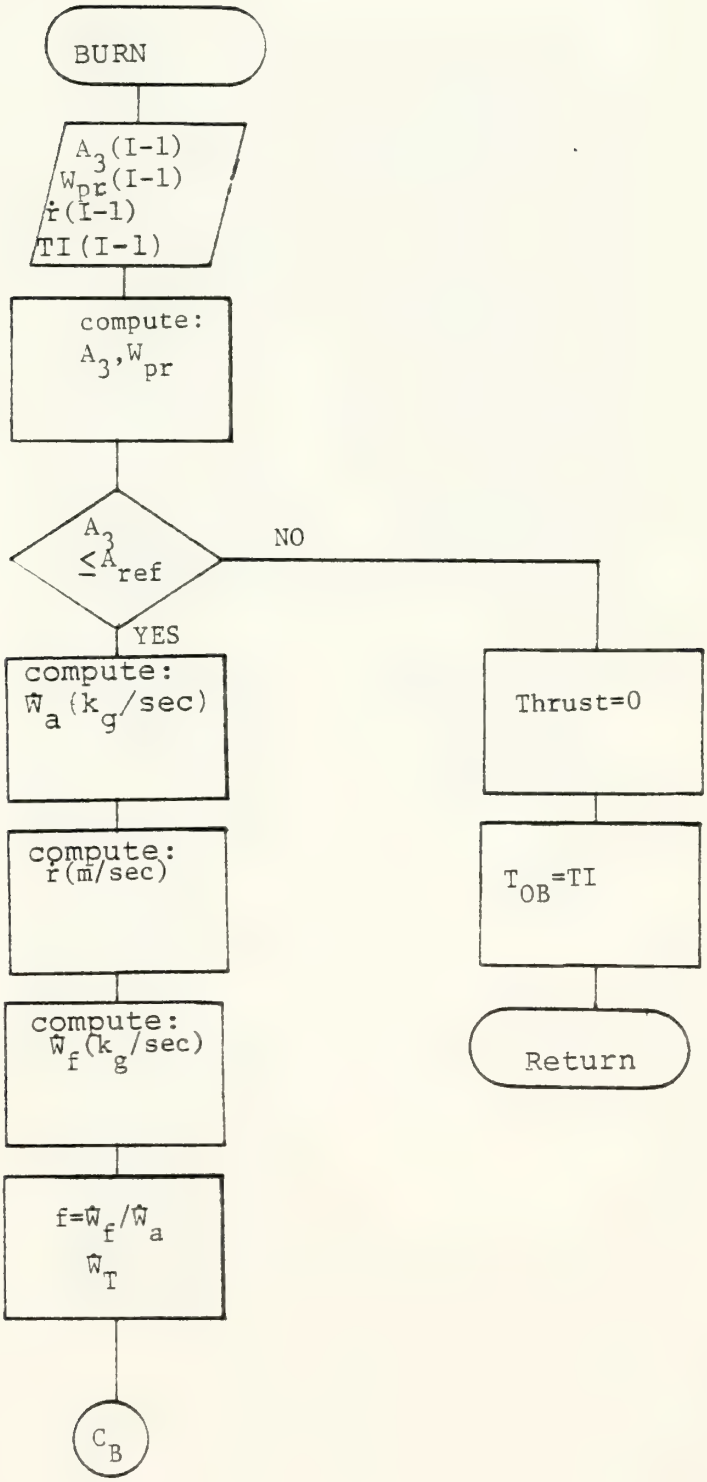

TRAJ
1st time ?
YES
initial conditions
NO
ATM
DRAGG
DYNA
print (TRJ,DRG)
Return

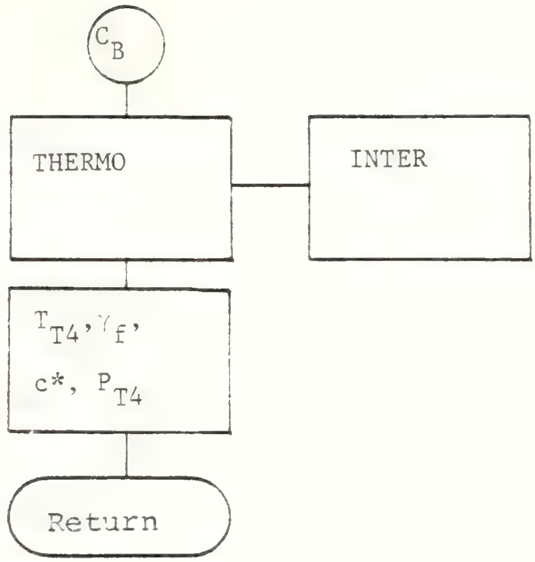
C 3. Individual Subroutines

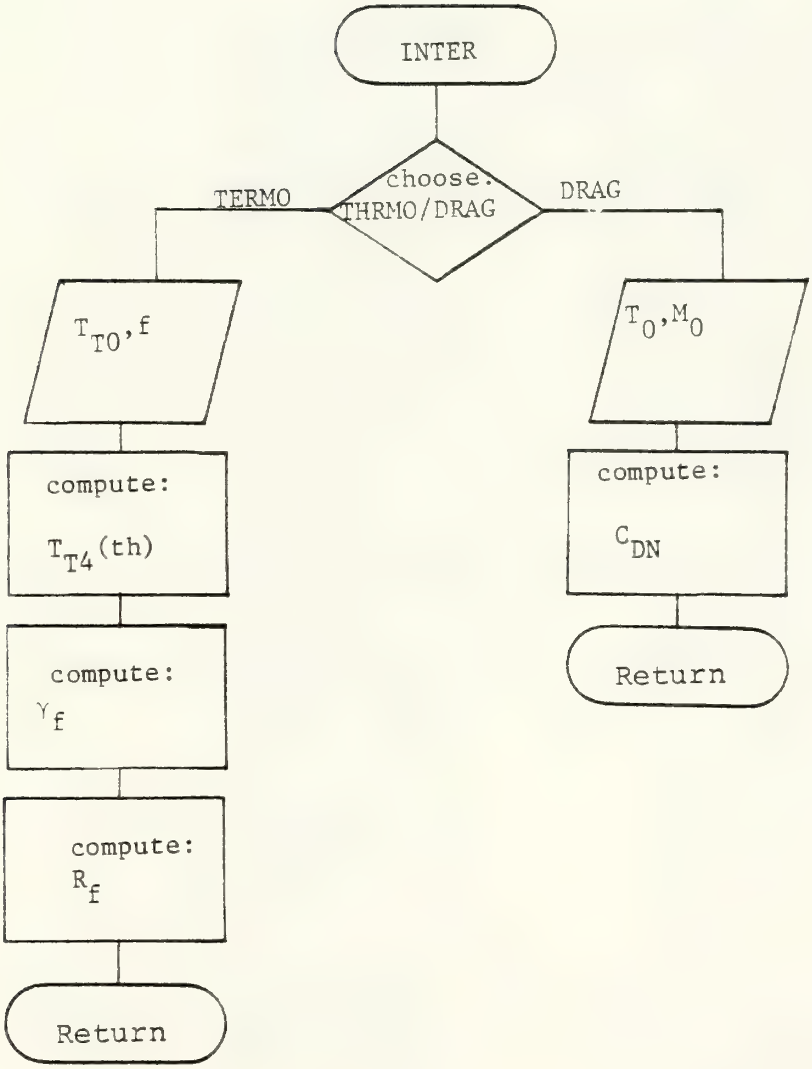


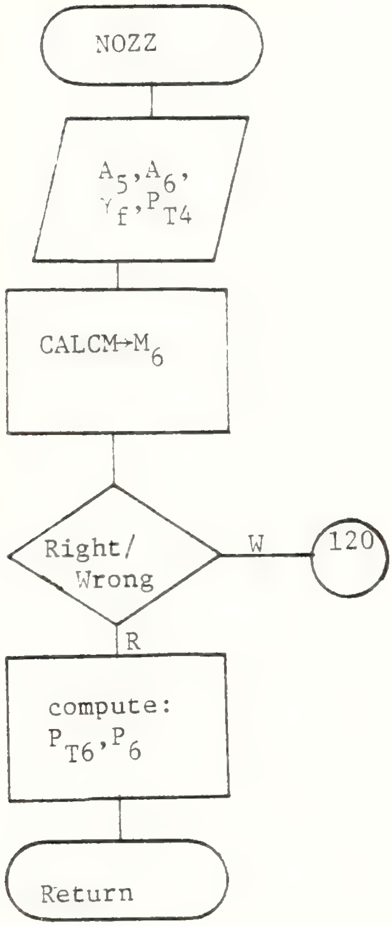

BOOS
ρ_B, I_{SP}, B
A_3, A_5, L_3
compute:
$W_B (k_g)$
compute:
U_{eq} (m/sec)
compute:
ΔU (m/sec)
Return
compute:
M_o
Continue

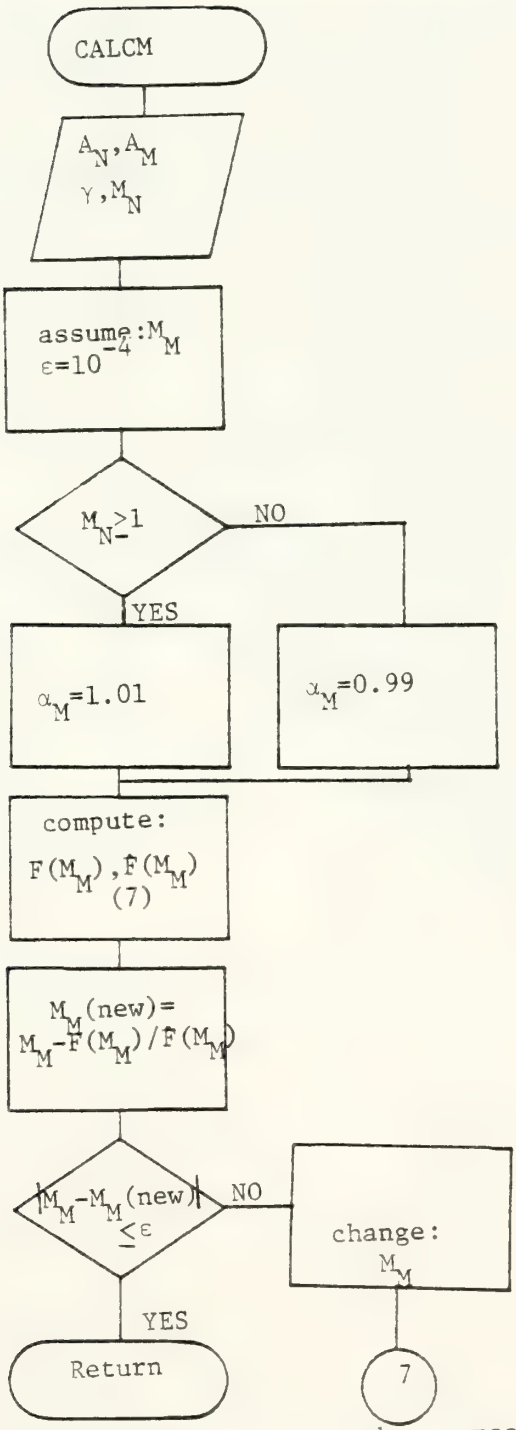

INIT
γ_a, M_0,
P_0, T_0
compute:
P_{T0}
compute:
T_{T0}
Return


BURN
A3(I-1)
Wpr(I-1)
ṙ(I-1)
TI(I-1)
compute:
A3,Wpr
A3
≤Aref
NO
YES
compute:
Ŵa(kg/sec)
compute:
ṙ(m/sec)
compute:
Ŵf(kg/sec)
f=Ŵf/Ŵa
ŴT
CB
Thrust=0
TOB=TI
Return

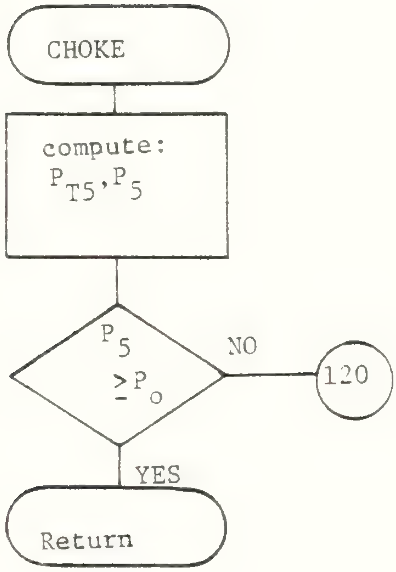

C_B
THERMO
INTER
T_{T4}, γ_f,
c^*, P_{T4}
Return

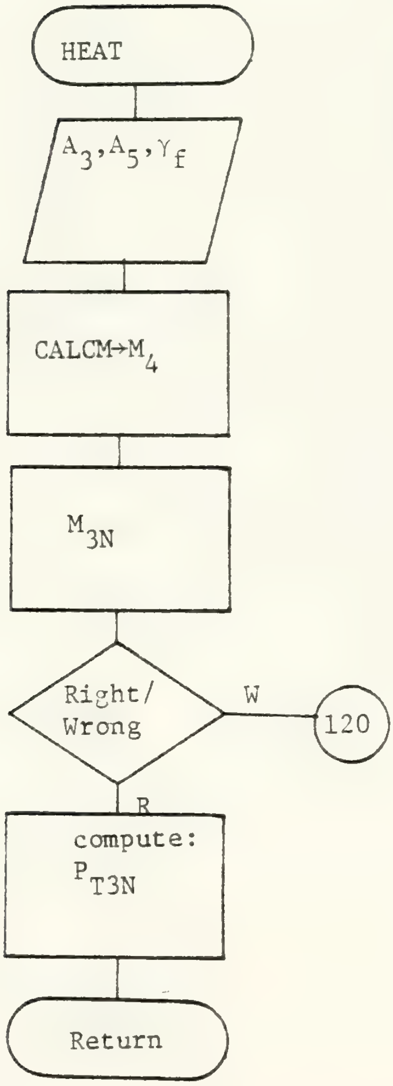

INTER
choose:
THRMO/DRAG
TERMO
DRAG
T_{T0}, f
compute:
T_{T4}(th)
compute:
γ_f
compute:
R_f
Return
T_0, M_0
compute:
C_{DN}
Return


NOZZ
$A_5, A_6,$
γ_f, P_{T4}
CALCM→M_6
Right/
Wrong
W
120
R
compute:
P_{T6}, P_6
Return

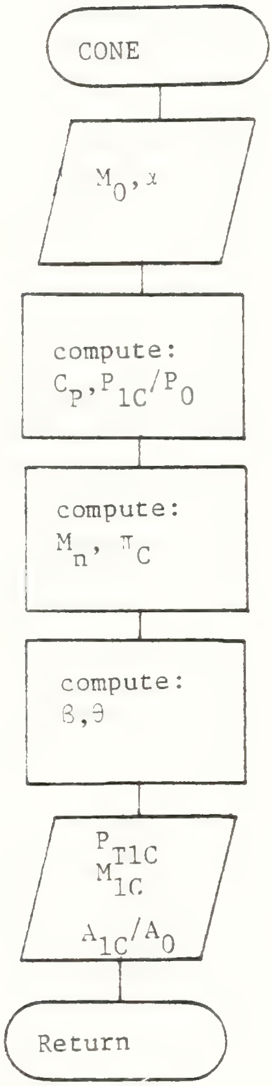


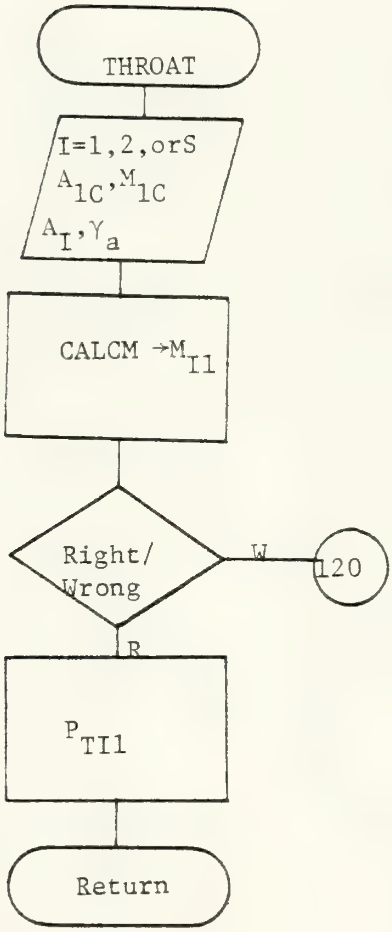
notes: 1. A_N, A_M = area at known and at unknown mach number, respectively.
$\gamma = \gamma_a$ or γ_f
M_N = known mach number
2. CALCD works in a similiar way.

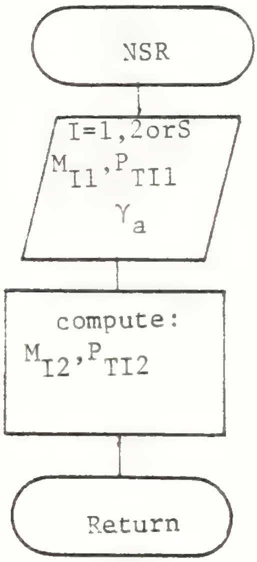

CHOKE
compute:
P_{T5}, P_5
P_5
$\geq P_o$
NO
120
YES
Return

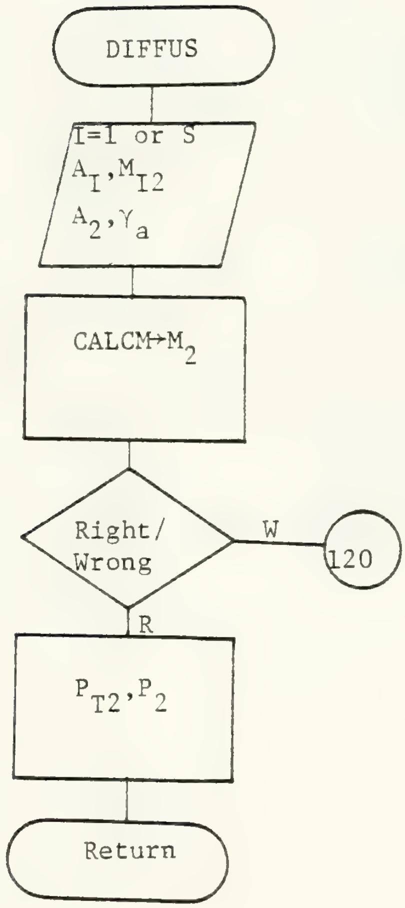

HEAT
A3,A5,γf
CALCM→M4
M3N
Right/
Wrong
W
120
R
compute:
PT3N
Return

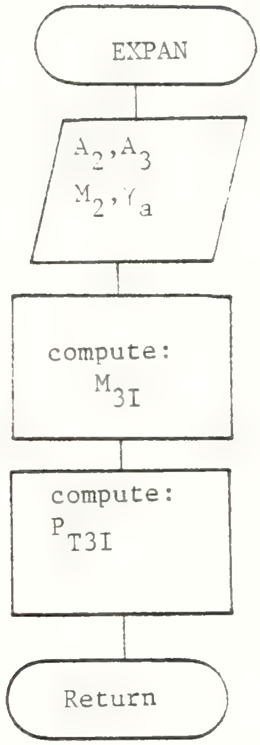
C3.8 INLET

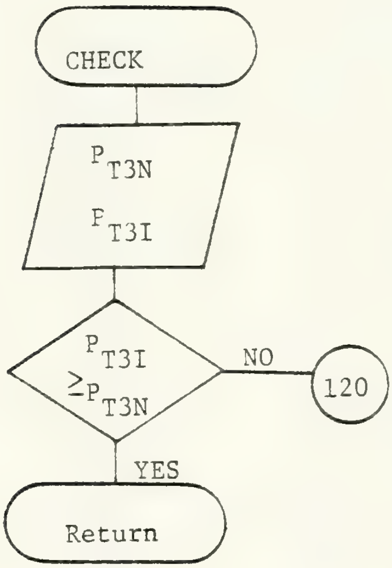

CONE
M_0, α
compute:
$C_p, P_{1C}/P_0$
compute:
M_n, π_C
compute:
β, θ
P_{T1C}
M_{1C}
A_{1C}/A_0
Return


THROAT
I=1,2,orS
A1C,M1C
AI,γa
CALCM →MI1
Right/
Wrong
W
120
R
PTI1
Return

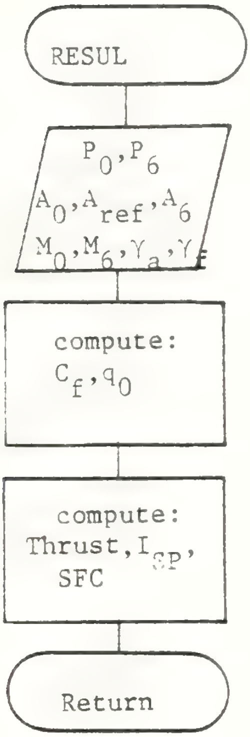

NSR
I=1,2orS
M_{I1}, P_{TI1}
γ_a
compute:
M_{I2}, P_{TI2}
Return

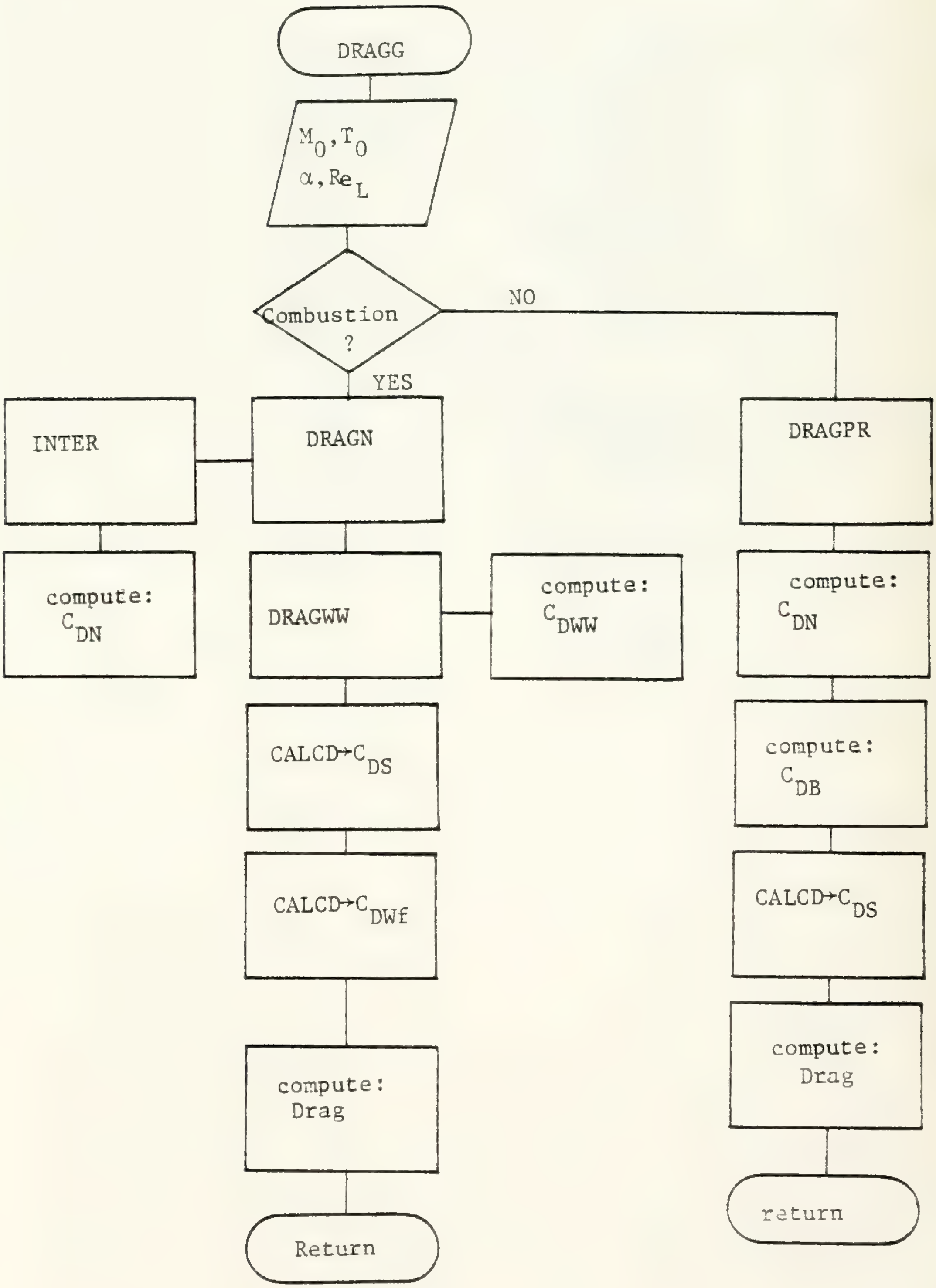

DIFFUS
I=1 or S
A_I, M_{I2}
A_2, γ_a
CALCM→M_2
Right/
Wrong
W
120
R
P_{T2}, P_2
Return

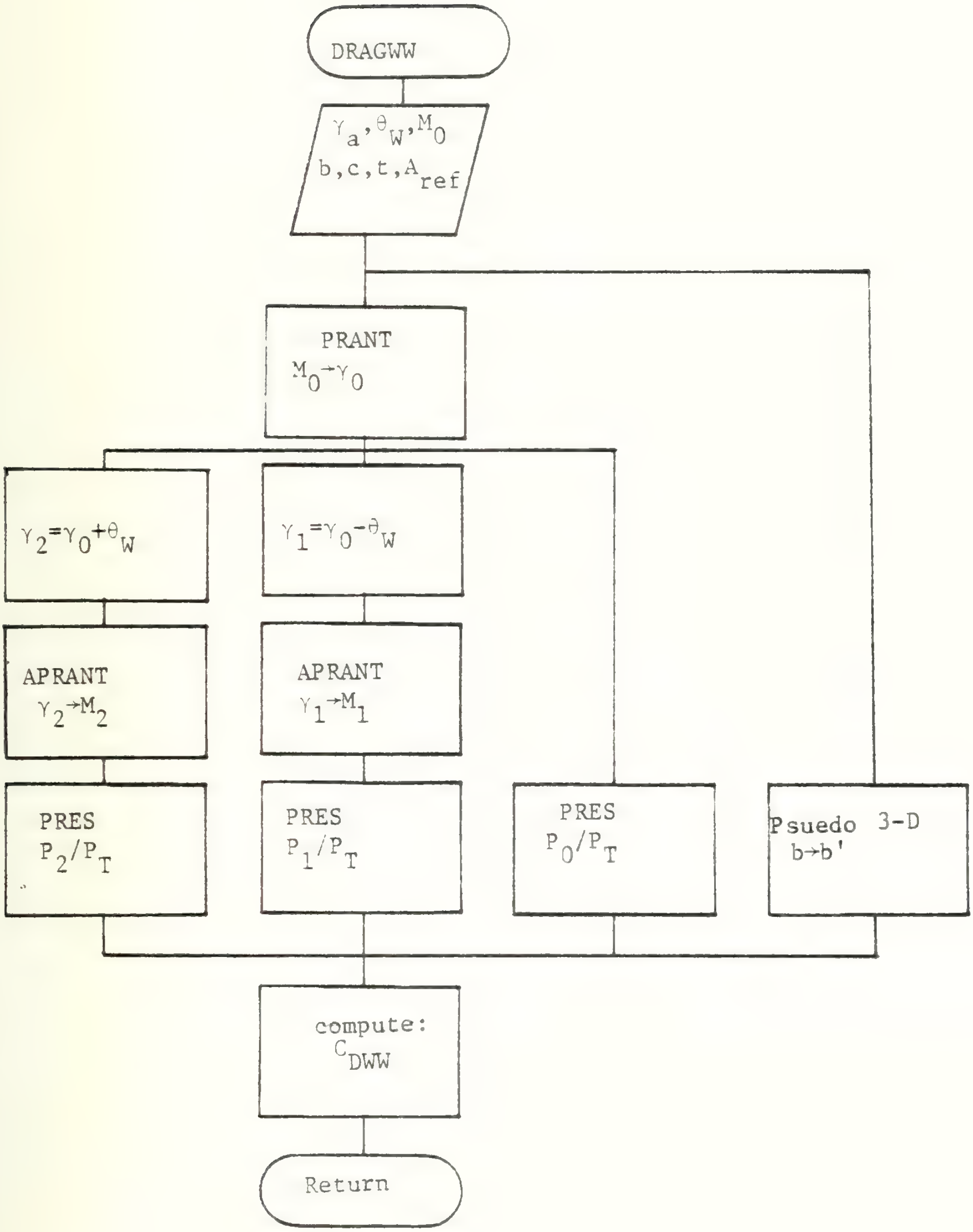

EXPAN
A_2, A_3
M_2, γ_a
compute:
M_{3I}
compute:
P_{T3I}
Return



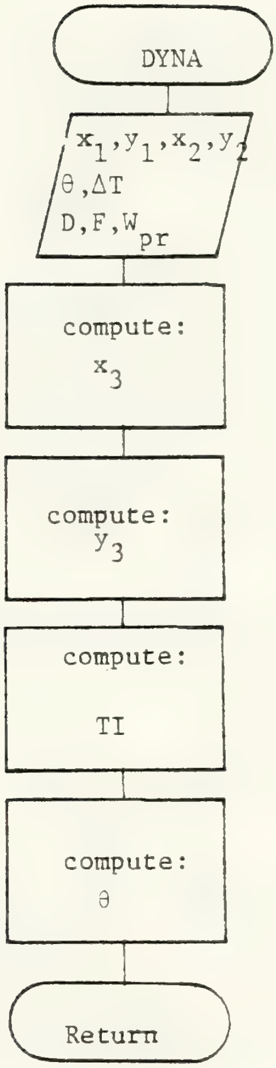
CHECK
P_{T3N}
P_{T3I}
$P_{T3I} \geq P_{T3N}$
NO
120
YES
Return


RESUL
P_0, P_6
A_0, A_{ref}, A_6
$M_0, M_6, \gamma_a, \gamma_f$
compute:
C_f, q_0
compute:
Thrust, I_{SP},
SFC
Return


DRAGG
M_0, T_0
α, Re_L
Combustion ?
NO
YES
INTER
DRAGN
DRAGPR
compute: C_{DN}
DRAGWW
compute: C_{DWW}
compute: C_{DN}
CALCD→C_{DS}
compute: C_{DB}
CALCD→C_{DWf}
CALCD→C_{DS}
compute: Drag
compute: Drag
Return
return



DRAGWW
γ_a, θ_W, M_0
b, c, t, A_{ref}
PRANT
$M_0 \rightarrow \gamma_0$
$\gamma_2 = \gamma_0 + \theta_W$
$\gamma_1 = \gamma_0 - \theta_W$
APRANT
$\gamma_2 \rightarrow M_2$
APRANT
$\gamma_1 \rightarrow M_1$
PRES
P_2/P_T
PRES
P_1/P_T
PRES
P_0/P_T
Psuedo 3-D
b→b'
compute:
C_{DWW}
Return


DYNA
x_1, y_1, x_2, y_2
$\theta, \Delta T$
D, F, W_{pr}
compute: x_3
compute: y_3
compute: TI
compute: θ
Return

APPENDIX D:

PROGRAM TRAJET: LISTING

```
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C                          PROGRAM TRAJET                              C
C                                                                      C
C        THIS IS A PROGRAM FOR SOLID FUEL RAMJET+TRAJECTORY            C
C                                                                      C
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC

      COMMON/GEO/AREF,A0,A1,A2,A30,A3,A5,A6,L3,A0AR,A5AR,ILOO,IPR
     ,,A1A0,A2A0,A6A5,A3AR
      COMMON/AIR/GA,GA1,GA2,GA12,GA3,RHOA,T0,P0,U0,M0,GRAV
      COMMON/FUEL/RHOF,FTAT,A,N
      COMMON/LOSS/PIC1,PID2,PIB1,PIB2,PIN
      COMMON/BLR/WA,WF,WT,F,RDOT,CSTAR,PT4,TT4
      COMMON/GFI/RF,GF,GF1,GF2,GF12,GF3
      COMMON/NOZ/M6,PT6,P6
      COMMON/RES/CF,THRUST,ISP,SFC
      COMMON/CHO/PT5,P5
      COMMON/INI/PT0,TT0
      COMMON/CON/PT1C,M1C,A1C,ALFA
      COMMON/THRO/M11,PT11,M21,PT21,MS1,PTS1
      COMMON/NS/M12,PT12,M22,PT22,MS2,PTS2
      COMMON/DIF/M2,PT2,P2
      COMMON/CHE/M3N,M3I,PT3,PT3M,M4,AS
      COMMON/TRA/PI,MUA,DRAG,RPR,LPR,WPR,U,WB,DELU,DELT,TI,TETA,IRAM,
     ,IL,ILO,Y,Y0,TOB,X1,Y1,X2,Y2,X3,Y3,WPRB,R,TORB,ITRA,TETAOD,XOB,YOB
      COMMON/DRG/TETP,CDN,CFT,CDWW,CDWF,APR,SPR,SWW,Q,XMO
      REAL M0,M1C,M11,M12,M2,M3N,M3I,M4,M5,M6
      REAL L3,N,ISP,M21,M22,MS1,MS2
      REAL MUA,LPR
      CALL DATTA
      IF(A6.GT.AREF)GO TO 120
      Y=0.
      CALL ATM
          IF(IRAM.EQ.0)GO TO 100
          ITRA=-1
          THRUST=0.
          DELU=C.
          GC TO 140
  100 THRUST=1.
      CALL BOOS
  140 U=U0+DELU
      M0=U/SQRT(GA*GRAV*R*T0)
      RDOT=0.
      DELT=0.
      WPR0=WPR
      A0AR=A0/AREF
      A5AR=A5/AREF
      A6A5=A6/A5
      A00=A0
      A1A0=A1/A0
      A2A0=A2/A0
      IPRIN=1
      IF(ITRA.GT.0) GO TO 155
      PRINT 800
  800 FORMAT(1H1,30X,'SOLID FUEL RAMJET & TRAJECTORY',//43X,'SUMMARY',//
     ,5X,'A0/AR',6X,'A5/AR',6X,'TOB',8X,'XOB',8X,'YOB',8X,'TOF',
     ,8X,'X(MAX)',5X,'Y(MAX)',5X,'TETP',7X,'TETA',/)
CC    THIS PART IS FOR A0,A5-CHANGES ONLY
          IEND=41
          IF(IRAM.EQ.1)IEND=26
      DO 111 IA5=26,IEND
      IF(IA5.EQ.1)GO TO 110
      A5=(IA5-1)*0.01*AREF
  110 A6=A6A5*A5
      IF(A6.GT.AREF)GO TO 120
      A0=A00
      DO 114 IA0=26,IEND
      ILOO=0
      Y=0.
          IF(IRAM.GT.1)IRAM=1
          IF(IRAM.EQ.1)GO TO 145
      THRUST=1.
```

```
      CALL ATM
      CALL BOOS
  145 U=UO+DELU
      MC=U/SQRT(GA*GRAV*R*TO)
      RCCT=0.
      DELT=0.
      WPR=WPRO
      ITRA=-1
      TI=0.
      TCRB=0.
      XCB=0.
      YCB=0.
      IF(IAO.EC.1)GO TO 113
      AO=(IAO-1)*0.01*AREF
      A1=A1AO*AO
      A2=A2AO*AO
  113 CONTINUE
      AOAR=AO/AREF
      A5AR=A5/AREF
  155    IF(IRAM.EQ.1)GO TO 150
      CALL INIT
      CALL BURN
      IF(ILOO.GT.1)GO TO 120
      IF(THRUST.LT.0.01)GO TO 150
      CALL NOZZ
      IF(ILOO.GT.1)GO TO 120
      CALL CHOKE
      IF(ILOO.GT.1)GO TO 120
      CALL HEAT
      IF(ILOO.GT.1)GO TO 120
      CALL INLET
      IF(ILOO.GT.1)GO TO 120
      CALL EXPAN
      CALL CHECK
         IF(ILOO.LE.1)GO TO 130
         THRUST=0.
         TOFB=TI
         XOB=X3
         YOB=Y3
         ILOO=0
         GO TO 150
  130 CALL CORVAL
      IF(ILOO.GT.1)GO TO 120
      CALL RESUL
      IF(ILOO.GT.1)GO TO 120
  150 CALL TRAJ
      IF(ILOO.GT.1)GO TO 120
      IF(IPR.LT.0)GO TO 152
      IF(THRUST.LE.0.01)GO TO 150
      IF(ITRA.LT.0) GO TO 155
      CALL PRILCO(IPRIN)
  152 IF(THRUST.LE.0.01)GO TO 150
      GO TO 155
  120 CONTINUE
      IF(ITRA.GT.0) GO TO 157
  114 CONTINUE
  111 CONTINUE
  157 PRINT 222,ILOO,AOAR,A5AR,A1AO,A2AO,A3AR,
     ,TETP,TETAOD,IPR,ITRA,XMO,PID1,PID2,PIN
  222 FORMAT(1H1,24('+'),I3,24('+'),/5X,'INPUT DATA:',/2X,5F10.3,
     +          /2X,2F6.1,2I3,4F6.3)
      STOP
      END

      SUBROUTINE INIT
      COMMON/GEO/AREF,AO,A1,A2,A30,A3,A5,A6,L3,AOAR,A5AR,ILOO,IPR
      COMMON/AIR/GA,GA1,GA2,GA12,GA3,RHOA,TO,PO,UO,MO,GRAV
      COMMON/FUEL/RHOF,ETAT,A,N
      COMMON/LOSS/PID1,PID2,PIB1,PIB2,PIN
      COMMON/BUR/WA,WF,WT,F,ROOT,CSTAR,PT4,TT4
      COMMON/GFT/RF,GF,GF1,GF2,GF12,GF3
      COMMON/NOZ/M6,PT6,P6
```

```
      COMMON/RES/CF,THRUST,ISP,SFC
      COMMON/CHO/PT5,P5
      COMMON/INI/PTO,TTO
      COMMON/CON/PT1C,M1C,A1C,ALFA
      COMMON/THRO/M11,PT11,M21,PT21,MS1,PTS1
      COMMON/NS/M12,PT12,M22,PT22,MS2,PTS2
      COMMON/DIF/M2,PT2,P2
      COMMON/CHE/M3N,M3I,PT3,PT3M,M4,AS
      REAL M0,M1C,M11,M12,M2,M3N,M3I,M4,M5,M6
      REAL L3,N,ISP,M21,M22,MS1,MS2
      GA1=(GA+1.)/2.
      GA2=(GA-1.)/2.
      GA3=GA/(GA-1.)
      GA12=GA1/GA2/2.
      PTC=PC*(1.+GA2*M0**2)**GA3
      TTC=T0*(1.+GA2*M0**2)
      RETURN
      END

      SUBROUTINE BURN
      COMMON/GEO/AREF,A0,A1,A2,A30,A3,A5,A6,L3,A0AR,A5AR,ILOO,IPR
      COMMON/AIR/GA,GA1,GA2,GA12,GA3,RHOA,T0,P0,U0,M0,GRAV
      COMMON/FUEL/RHOF,ETAT,A,N
      COMMON/LOSS/PID1,PID2,PIB1,PIB2,PIN
      COMMON/ELR/WA,WF,WT,F,ROOT,CSTAR,PT4,TT4
      COMMON/GFI/RF,GF,GF1,GF2,GF12,GF3
      COMMON/NOZ/M6,PT6,P6
      COMMON/RES/CF,THRUST,ISP,SFC
      COMMON/CHO/PT5,P5
      COMMON/INI/PTO,TTO
      COMMON/CON/PT1C,M1C,A1C,ALFA
      COMMON/THRO/M11,PT11,M21,PT21,MS1,PTS1
      COMMON/NS/M12,PT12,M22,PT22,MS2,PTS2
      COMMON/DIF/M2,PT2,P2
      COMMON/CHE/M3N,M3I,PT3,PT3M,M4,AS
      COMMON/TRA/PI,MUA,DRAG,RPR,LPR,WPR,U,WB,DELU,DELT,TI,TETA,IRAM,
     ,IL,ILO,Y,Y0,T0B,X1,Y1,X2,Y2,X3,Y3,WPRB,R,TORB,ITRA,TETAOD,XOB,YOB
      REAL M0,M1C,M11,M12,M2,M3N,M3I,M4,M5,M6
      REAL L3,N,ISP,M21,M22,MS1,MS2,MUA,LPR
      A31=A3
      A3=PI/4.*(SQRT(4./PI*A30)+2.*ROOT*TI)**2
CCC   IN CALCULATING WPR IT IS ASSUMED THAT THE ORIGINAL WPR EXCLUDE WB
      WPR=WPR-((A3-A31)*L3*RHOF)
      IF(A3.LE.AREF) GO TO 22
      THRUST=0.
      TORB=TI
      XOB=X3
      YOB=Y3
      RETURN
   22 WA=RHOA*U0*A0*.9
CCC   WA=RHOA*U0*A0*(AC/A0),TAKING (  )=.9
      WAA3=WA/A3
      WAA3=WAA3*0.0254**2/0.45359
CCC   GIVES WAA3 IN LB/IN2
      ROOT=A*WAA3**N
CCC   ROOT=0.06*(WAA3 LB/IN2)**0.6 IN/SEC
      ROOT=ROOT*0.0254
      WF=RHOF*ROOT*SQRT(4.*3.14159*A3)*L3
CCC   WF=RHOF*ROOT*PI*D3*L3,WHEN D3= SQRT(4/PI*A3)
      F=WF/WA
      WT=WA+WF
      CALL TERMO(TTO,F,TT4,GF,RF)
      IF(ILOO.GT.1)RETURN
      TT4=ETAT*(TT4-TTC)+TTO
      GF1=(GF+1.)/2.
      GF2=(GF-1.)/2.
      GF12=GF1/GF2/2.
      GF3=GF/(GF-1.)
      GFUN=SQRT(GF)*(1./GF1)**GF12
      CSTAR=SQRT(GRAV*RF*TT4)/GFUN
      PT4=WT*CSTAR/(GRAV*A5)
CCC   GIVES PT4 IN KG/M2
```

```
      RETURN
      END
      SUBROUTINE TERMO(TTOP,FAP,TT4P,GFP,RFP)
      COMMON/GEO/AREF,A0,A1,A2,A30,A3,A5,A6,L3,A0AR,A5AR,ILOO,IPR
      CALL INTER(1,TTOP,FAP,TT4P)
      CALL INTER(2,TTOP,FAP,GFP)
      CALL INTER(3,TTOP,FAP,RFP)
      IF(ILOO.GT.1)ILOO=2
      RETURN
      END
C
      SUBROUTINE INTER(IDATA,ZP,XP,YP)
      COMMON/GEO/AREF,A0,A1,A2,A30,A3,A5,A6,L3,A0AR,A5AR,ILOO,IPR
      DIMENSION ZVEC(5),XVEC(20),YVEC(5,20),YZ(5)
     *,TTOVEC(5),FAVEC(20),IETVEC(5),XMVEC(20)
     *,DATO(20),DATT2(20),DATT3(20),DATT4(20),DATT5(20)
     *,DATG2(20),DATG3(20),DATG4(20),DATG5(20)
     *,DATR2(20),DATR3(20),DATR4(20),DATR5(20)
     *,DATCD2(20),DATCD3(20),DATCD4(20),DATCD5(20)
C
      YP=0.
CCC                DATA FOR TERMO SUBROUTINE
      DATA FAVEC/0.,.01,.02,.03,.04,.05,.0571,.0667,.073,.077,.083,
     *.091,.1,.111,.1266,.20,.21,.23,.25,.30/
C
      DATA TTOVEC/0.,311.,444.,750.,833./
C
      DATA DATC/0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,
     *0.,0.,0.,0.,0.,0.,0.,0./
      DATA DATT2/0.,705.,1049.,1364.,1643.,1912.,
     *2082.,2279.,2362.,2390.,2351.,2278.,2184.,2071.,1920.,1326.
     *,1240.,1070.,900.,474./
      DATA DATT3/0.,815.,1150.,1470.,1751.,2010.,
     *2172.,2352.,2424.,2443.,2427.,2360.,2273.,2160.,2015.,1455.
     *,1300.,1125.,950.,515./
      DATA DATT4/0.,1106.,1422.,1719.,1980.,2215.,
     *2345.,2490.,2551.,2569.,2573.,2530.,2459.,2352.,2200.,1568.
     *,1420.,1290.,1115.,662./
      DATA DATT5/0.,1183.,1494.,1786.,2042.,2270.,
     *2400.,2532.,2584.,2602.,2608.,2577.,2508.,2404.,2255.,1619.
     *,1520.,1340.,1165.,711./
C
      DATA DATG2/0.,1.35,1.32,1.30,1.28,1.27,1.26,1.25,
     *1.25,1.25,1.25,1.26,1.26,1.27,1.28,1.33,1.33,1.34,1.35,1.36/
      DATA DATG3/0.,1.35,1.32,1.30,1.28,1.27,1.26,1.25,
     *1.25,1.25,1.25,1.26,1.26,1.27,1.28,1.31,1.32,1.33,1.34,1.36/
      DATA DATG4/0.,1.33,1.30,1.29,1.27,1.26,1.25,1.25,
     *1.25,1.25,1.25,1.26,1.26,1.27,1.28,1.33,1.33,1.34,1.35,1.36/
      DATA DATG5/0.,1.33,1.30,1.28,1.27,1.26,1.26,1.25,
     *1.25,1.25,1.25,1.26,1.26,1.27,1.28,1.32,1.32,1.33,1.34,1.36/
C
      DATA DATR2/0.,29.03,29.10,29.16,29.22,29.28,
     *29.32,29.24,29.18,29.04,28.69,28.21,27.64,27.00,26.29,23.03,
     *22.58,21.65,20.75,18.5/
      DATA DATR3/0.,29.03,29.10,29.16,29.23,29.28,
     *29.30,29.24,29.11,28.97,28.60,28.20,27.60,27.00,26.20,23.87,
     *22.56,21.7,20.8,17.7/
      DATA DATR4/0.,29.03,29.10,29.16,29.22,29.20,
     *29.20,29.10,28.93,28.79,28.58,28.00,27.60,26.76,26.20,22.97,
     *22.55,21.6,20.7,18.4/
      DATA DATR5/0.,29.02,29.10,29.16,29.21,29.20,
     *29.20,29.10,28.90,28.73,28.51,28.00,27.58,26.75,26.20,22.97,
     *22.55,21.6,20.7,18.4/
C
CCC                DATA FOR DRAGN SUBROUTINE
      DATA IETVEC/0.,6.5,9.5,12.0,15.0/
      DATA XMVEC/0.,1.45,2.00,2.10,2.20,2.30,2.35,2.40,2.45,2.50,2.55
     *,2.60,2.65,2.70,2.75,2.80,2.85,2.90,3.00/
C
      DATA DATCD2/0.0,0.1162,0.0766,0.0726,0.0691,0.0659,0.0644,0.0630
     *,0.0617,0.0604,0.0592,0.0581,0.057,0.0559,0.0549,0.0539,0.0530
```

```
     *,0.0521,0.0504/
      DATA DATCD3/0.0,0.1638,0.1106,0.1049,0.099,0.0953,0.0932,0.0912
     *,0.0893,0.0875,0.0858,0.0841,0.0826,0.0811,0.0796,0.0782,0.0769
     *,0.0744,0.0732/
      DATA DATCD4/0.0,0.2210,0.1504,0.1428,0.1361,0.1300,0.1272,0.1246
     *,0.1220,0.1196,0.117,0.1151,0.113,0.1109,0.1090,0.1071,0.1054
     *,0.1036,0.1004/
      DATA DATCD5/0.0,0.3009,0.2136,0.2032,0.1938,0.1855,0.1816,0.1779
     *,0.1744,0.1710,0.1678,0.1647,0.1618,0.1590,0.1563,0.1537,0.1512
     *,0.1488,0.1443/
C
      GO TO (21,21,21,24),IDATA
   21 IZ=0
      IDA=20
      DO 22 IZ=1,5
   22 ZVEC(IZ)=TTOVEC(IZ)
      GO TO 29
   24 IZ=0
      IDA=19
      DO 25 IZ=1,5
   25 ZVEC(IZ)=TETVEC(IZ)
   29 GO TO (31,33,35,37),IDATA
   31 IFA=0
      DO 51 IFA=1,IDA
      XVEC(IFA)=FAVEC(IFA)
      YVEC(1,IFA)=DATO(IFA)
      YVEC(2,IFA)=DATT2(IFA)
      YVEC(3,IFA)=DATT3(IFA)
      YVEC(4,IFA)=DATT4(IFA)
   51 YVEC(5,IFA)=DATT5(IFA)
      GO TO 39
   33 IFA=0
      DO 53 IFA=1,IDA
      XVEC(IFA)=FAVEC(IFA)
      YVEC(1,IFA)=DATO(IFA)
      YVEC(2,IFA)=DATG2(IFA)
      YVEC(3,IFA)=DATG3(IFA)
      YVEC(4,IFA)=DATG4(IFA)
   53 YVEC(5,IFA)=DATG5(IFA)
      GO TO 39
   35 IFA=0
      DO 55 IFA=1,IDA
      XVEC(IFA)=FAVEC(IFA)
      YVEC(1,IFA)=DATO(IFA)
      YVEC(2,IFA)=DATR2(IFA)
      YVEC(3,IFA)=DATR3(IFA)
      YVEC(4,IFA)=DATR4(IFA)
   55 YVEC(5,IFA)=DATR5(IFA)
      GO TO 39
   37 IFA=0
      DO 57 IFA=1,IDA
      XVEC(IFA)=XMVEC(IFA)
      YVEC(1,IFA)=DATO(IFA)
      YVEC(2,IFA)=DATCD2(IFA)
      YVEC(3,IFA)=DATCD3(IFA)
      YVEC(4,IFA)=DATCD4(IFA)
   57 YVEC(5,IFA)=DATCD5(IFA)
C
   39 IF((ZP+1.0E-06).LT.ZVEC(2))GO TO 67
      IF((ZP-1.0E-06).GT.ZVEC(5))GO TO 67
      IF((XP+1.0E-06).LT.XVEC(2))GO TO 67
      IF((XP-1.0E-06).GT.XVEC(IDA))GO TO 67
      IF(IDATA.GT.4)GO TO 67
      IFA=1
      DO 61 IFA=2,IDA
      IF((XP-1.0E-06)-XVEC(IFA))63,63,65
   63 IT=1
      DO 71 IT=2,5
      IF((ZP-1.0E-06)-ZVEC(IT))73,73,75
   73 IT1=0
      DO 81 IT1=1,2
      IT0=IT-2+IT1
```

```
      YZ(ITO)=(XP-XVEC(IFA-1))/(XVEC(IFA)-XVEC(IFA-1))*
     *(YVEC(ITO,IFA)-YVEC(ITO,(IFA-1)))+YVEC(ITO,(IFA-1))
   81 CONTINUE
      YP=(ZP-ZVEC(IT-1))/(ZVEC(IT)-ZVEC(IT-1))*
     *(YZ(IT)-YZ(IT-1))+YZ(IT-1)
      RETURN
   75 CONTINUE
   71 CONTINUE
   65 CONTINUE
   61 CONTINUE
   67 ILOO=10
      IF(IPR.LT.1)RETURN
      PRINT 69,A5AR,A0AR,ZP,XP,IDATA
   69 FORMAT(1X,2F7.3,5X,2F12.4,I3,5X,'MISSING DATA TO INTER')
      RETURN
      END

      SUBROUTINE NOZZ
      COMMON/GEO/AREF,A0,A1,A2,A30,A3,A5,A6,L3,A0AR,A5AR,ILOO,IPR
      COMMON/AIR/GA,GA1,GA2,GA12,GA3,RHOA,T0,P0,U0,M0,GRAV
      COMMON/FUEL/RHOF,ETAT,A,N
      COMMON/LOSS/PI01,PI02,PIB1,PIB2,PIN
      COMMON/BUR/WA,WF,WT,F,ROOT,CSTAR,PT4,TT4
      COMMON/GFI/RF,GF,GF1,GF2,GF12,GF3
      COMMON/NOZ/M6,PT6,P6
      COMMON/RES/CF,THRUST,ISP,SFC
      COMMON/CHO/PT5,P5
      COMMON/INI/PT0,TT0
      COMMON/CON/PT1C,M1C,A1C,ALFA
      COMMON/THRO/M11,PT11,M21,PT21,MS1,PTS1
      COMMON/NS/M12,PT12,M22,PT22,MS2,PTS2
      COMMON/DIF/M2,PT2,P2
      COMMON/CHE/M3N,M3I,PT3,PT3M,M4,AS
      REAL M0,M1C,M11,M12,M2,M3N,M3I,M4,M5,M6
      REAL L3,N,ISP,M21,M22,MS1,MS2
      M6=1.0
      CALL CALCM(M6,A5,A6,GF1,GF2,GF12)
      IF(ILOO.LE.1)GO TO 11
      ILOO=3
      RETURN
   11 PT6=PT4*PIN
      P6=PT6*(1.+GF2*M6**2)**(-GF3)
      RETURN
      END

      SUBROUTINE CALCM(X,AN,AM,G1,G2,G12)
      COMMON/GEO/AREF,A0,A1,A2,A30,A3,A5,A6,L3,A0AR,A5AR,ILOO,IPR
CCC   THIS SECTION COMPUTES MACH NUMBER FROM AREA RATIOS.
CCC   THE BASIC FORMULA IS:
CCC   AN/AM=(G1/(1+G2*X**2))**G12*X
CCC   DATA NEEDED:AN=AREA AT KNOWN MACH NUMBER
CCC               AM=AREA AT NEW MACH NUMBER
CCC               G1,G2,G12=GAMMA RATIOS FOR:
CCC                 -AIR FLOW(GA1,GA2,GA12)
CCC                 -HOT FLOW(GF1,GF2,GF12)
CCC               X=KNOWN MACH NUMBER AT AN(=XAN)
CCC   X IS THE COMPUTED MACH NUMBER(THE SAME X IS USED FOR IN/OUT)
      IMACH=1
      XAN=X
      IF(XAN-1.0)4,5,5
    4 ALFA=0.99
      GO TO 6
    5 ALFA=1.01
    6 CONTINUE
      EPS=1.E-04
    7 GFUN=(G1/(1.+G2*X**2))
      FX=X*GFUN**G12-AN/AM
      IF(IPR.EQ.3)PRINT 999,X,FX
  999 FORMAT(6X,2F10.4)
      FXDOT=(GFUN**G12)*(1.-2.*G2*G12/ALFA*(X**2)/(1.+G2*X**2))
      XNEW=X-FX/FXDOT
      DIFF=ABS(X-XNEW)
```

```
      IF(DIFF.LE.EPS)RETURN

      IF(IMACH.GT.10)GO TO 9
      IMACH=IMACH+1
      X=XNEW
      IF(XAN-1.0)14,15,15
   14 IF(X.GE.1.0) X=0.7
      IF(X.LE.0.)X=0.3
      GO TO 7
   15 IF(X.LE.1.0) X=1.8
      IF(X.GE.10.) X=3.
      GO TO 7
    9 ILOO=10
      IF(IPR.LT.1) RETURN
      PRINT 10,A5AR,A0AR
   10 FORMAT(1X,2F7.3,3X,'SUITABLE SOLUTION WAS NOT FOUND AFTER 6 ITER')
      IF(IPR.GE.2)CALL PRIN
      RETURN
      END

      SUBROUTINE RESUL
      COMMON/GEO/AREF,A0,A1,A2,A30,A3,A5,A6,L3,A0AR,A5AR,ILOO,IPR
      COMMON/AIR/GA,GA1,GA2,GA12,GA3,RHOA,T0,P0,U0,M0,GRAV
      COMMON/FUEL/RHOF,FTAT,A,N
      COMMON/LOSS/PID1,PID2,PIB1,PIB2,PIN
      COMMON/BUR/WA,WF,WT,F,ROOT,CSTAR,PT4,TT4
      COMMON/GFI/RF,GF,GF1,GF2,GF12,GF3
      COMMON/NOZ/M6,PT6,P6
      COMMON/RES/CF,THRUST,ISP,SFC
      COMMON/CHO/PT5,P5
      COMMON/INI/PT0,TT0
      COMMON/CON/PT1C,M1C,A1C,ALFA
      COMMON/THRO/M11,PT11,M21,PT21,MS1,PTS1
      COMMON/NS/M12,PT12,M22,PT22,MS2,PTS2
      COMMON/DIF/M2,PT2,P2
      COMMON/CHE/M3N,M3I,PT3,PT3M,M4,AS
      REAL M0,M1C,M11,M12,M2,M3N,M3I,M4,M5,M6
      REAL L3,N,ISP,M21,M22,MS1,MS2
      PRAT=PT6/P0/(PT6/P6)
      CF=2.*A6/AREF/(GA*M0**2)*(PRAT*(1.+GF*M6**2)-1.)-2*A0/AREF
      IF(CF.GT.0.)GO TO 22
      ILOO=9
      RETURN
   22 Q0=.5*GA*P0*M0**2
      THRUST=CF*Q0*AREF*GRAV
      ISP=THRUST/WF
      SFC=3600./ISP
C     DIMENSIONS: THRUST IN NEWTON(N), ISP IN N/(KG/SEC), SFC IN KG/N.
      RETURN
      END

      SUBROUTINE CHOKE
      COMMON/GEO/AREF,A0,A1,A2,A30,A3,A5,A6,L3,A0AR,A5AR,ILOO,IPR
      COMMON/AIR/GA,GA1,GA2,GA12,GA3,RHOA,T0,P0,U0,M0,GRAV
      COMMON/FUEL/RHOF,FTAT,A,N
      COMMON/LOSS/PID1,PID2,PIB1,PIB2,PIN
      COMMON/BUR/WA,WF,WT,F,ROOT,CSTAR,PT4,TT4
      COMMON/GFI/RF,GF,GF1,GF2,GF12,GF3
      COMMON/NOZ/M6,PT6,P6
      COMMON/RES/CF,THRUST,ISP,SFC
      COMMON/CHO/PT5,P5
      COMMON/INI/PT0,TT0
      COMMON/CON/PT1C,M1C,A1C,ALFA
      COMMON/THRO/M11,PT11,M21,PT21,MS1,PTS1
      COMMON/NS/M12,PT12,M22,PT22,MS2,PTS2
      COMMON/DIF/M2,PT2,P2
      COMMON/CHE/M3N,M3I,PT3,PT3M,M4,AS
      REAL M0,M1C,M11,M12,M2,M3N,M3I,M4,M5,M6
      REAL L3,N,ISP,M21,M22,MS1,MS2
      PT5=PT4*SQRT(PIN)
      P5=PT5*(1./GF1)**GF3
      IF(P5.GE.P0) RETURN
```

```
      ILOO=4
      IF(IPR.LT.1)RETURN
      PRINT 53,A5AR,A0AR,P5
   53 FORMAT(1X,2F7.3,3X,'NOZZLE IS NOT CHOKED,P5=',E10.2)
      IF(IPR.GE.2)CALL PRIN
      RETURN
      END

      SUBROUTINE INLET
      COMMON/GEO/AREF,A0,A1,A2,A30,A3,A5,A6,L3,A0AR,A5AR,ILOO,IPR
      COMMON/AIR/GA,GA1,GA2,GA12,GA3,RHOA,T0,P0,U0,M0,GRAV
      COMMON/FUEL/RHOF,ETAT,A,N
      COMMON/LOSS/PID1,PID2,PIB1,PIB2,PIN
      COMMON/BLP/WA,WF,WT,F,ROOT,CSTAR,PT4,TT4
      COMMON/GFI/RF,GF,GF1,GF2,GF12,GF3
      COMMON/NOZ/M6,PT6,P6
      COMMON/RES/CF,THRUST,ISP,SFC
      COMMON/CHO/PT5,P5
      COMMON/INI/PT0,TT0
      COMMON/CON/PT1C,M1C,A1C,ALFA
      COMMON/THRO/M11,PT11,M21,PT21,MS1,PTS1
      COMMON/NS/M12,PT12,M22,PT22,MS2,PTS2
      COMMON/DIF/M2,PT2,P2
      COMMON/CHE/M3N,M3I,PT3,PT3M,M4,AS
      REAL M0,M1C,M11,M12,M2,M3N,M3I,M4,M5,M6
      REAL L3,N,ISP,M21,M22,MS1,MS2
      CALL CONE
      CALL MIN
      IF(ILOO.LE.1)GO TO 11
      ILOO=61
      RETURN
   11 CALL THRCAT(1,M11,A1)
      IF(ILOO.LE.1)GO TO 13
      ILOO=62
      RETURN
   13 CALL NSR(1,M11,M12,PT11,PT12)
      CALL DIFFUS(1,A1,M12)
      IF(ILOO.GT.1)ILOO=63
      RETURN
      END

      SUBROUTINE CONE
      COMMON/GEO/AREF,A0,A1,A2,A30,A3,A5,A6,L3,A0AR,A5AR,ILOO,IPR
      COMMON/AIR/GA,GA1,GA2,GA12,GA3,RHOA,T0,P0,U0,M0,GRAV
      COMMON/FUEL/RHOF,ETAT,A,N
      COMMON/LOSS/PID1,PID2,PIB1,PIB2,PIN
      COMMON/BLP/WA,WF,WT,F,ROOT,CSTAR,PT4,TT4
      COMMON/GFI/RF,GF,GF1,GF2,GF12,GF3
      COMMON/NOZ/M6,PT6,P6
      COMMON/RES/CF,THRUST,ISP,SFC
      COMMON/CHO/PT5,P5
      COMMON/INI/PT0,TT0
      COMMON/CON/PT1C,M1C,A1C,ALFA
      COMMON/THRO/M11,PT11,M21,PT21,MS1,PTS1
      COMMON/NS/M12,PT12,M22,PT22,MS2,PTS2
      COMMON/DIF/M2,PT2,P2
      COMMON/CHE/M3N,M3I,PT3,PT3M,M4,AS
      REAL M0,M1C,M11,M12,M2,M3N,M3I,M4,M5,M6
      REAL L3,N,ISP,M21,M22,MS1,MS2
      REAL MN,M1
CCC   ALFA IS THE HALF ANGLE OF THE CONE
      CP=(.083+.096/M0**2)*(ALFA/10.)**1.69
      P1P0=1.+CP*GA/2*M0**2
      MN=SQRT(1.+(P1P0-1.)*(GA+1)/(2*GA))
      PT1PT0=P1P0**(-1./(GA-1.))*((GA+1)*MN**2/
     /((GA-1)*MN**2+2.))**(GA/(GA-1))
      BETA=ASIN(MN/M0)
      TETA=ATAN(2.*COTAN(BETA)*(MN**2-1.)/
     /(M0**2*(GA+COS(2*BETA))+2.))
      M1=SQRT((1.+(GA-1)/2*MN**2)/(GA*MN**2-(GA-1)/2)/
     /(SIN(BETA-TETA))**2)
      A1A0=(1.-TAN(TETA)/TAN(BETA))*COS(TETA)
```

```
      PT1C=PT0*PT1PT0
      M1C=M1
      A1C=A0*A1A0
      RETURN
      END

      SUBROUTINE MIN
      COMMON/GEO/AREF,A0,A1,A2,A30,A3,A5,A6,L3,A0AR,A5AR,ILOO,IPR
      COMMON/AIR/GA,GA1,GA2,GA12,GA3,RHOA,T0,P0,U0,M0,GRAV
      COMMON/FUEL/RHCF,ETAT,A,N
      COMMON/LOSS/PID1,PID2,PIB1,PIB2,PIN
      COMMON/BUR/WA,WF,WT,F,RDOT,CSTAR,PT4,TT4
      COMMON/GFI/RF,GF,GF1,GF2,GF12,GF3
      COMMON/NOZ/M6,PT6,P6
      COMMON/RES/CF,THRUST,ISP,SFC
      COMMON/CHO/PT5,P5
      COMMON/INI/PT0,TT0
      COMMON/CON/PT1C,M1C,A1C,ALFA
      COMMON/THRO/M11,PT11,M21,PT21,MS1,PTS1
      COMMON/NS/M12,PT12,M22,PT22,MS2,PTS2
      COMMON/DIF/M2,PT2,P2
      COMMON/CHE/M3N,M3I,PT3,PT3M,M4,AS
      REAL M0,M1C,M11,M12,M2,M3N,M3I,M4,M5,M6
      REAL L3,N,ISP,M21,M22,MS1,MS2
      CALL THROAT(2,M21,A2)
      CALL NSR(2,M21,M22,PT21,PT22)
      M2=M22
      PT2=PT22
      P2=PT2*(1.+GA2*M2**2)**(-GA3)
      CALL EXPAN
      IF(ILOO.GT.1)RETURN
      IF(PT3M.LE.PT3)RETURN
      ILOO=10
      IF(IPR.LT.1)RETURN
      PRINT 33,A5AR,A0AR
   33 FORMAT(1X,2F7.3,3X,'PT3 IS LESS THAN MIN VALUE ALLOWED')
      IF(IPR.GE.2)CALL PRIN
      RETURN
      END

      SUBROUTINE THROAT(I,MI1,AI)
      COMMON/GEO/AREF,A0,A1,A2,A30,A3,A5,A6,L3,A0AR,A5AR,ILOO,IPR
      COMMON/AIR/GA,GA1,GA2,GA12,GA3,RHOA,T0,P0,U0,M0,GRAV
      COMMON/FUEL/RHCF,ETAT,A,N
      COMMON/LOSS/PID1,PID2,PIB1,PIB2,PIN
      COMMON/BUR/WA,WF,WT,F,RDOT,CSTAR,PT4,TT4
      COMMON/GFI/RF,GF,GF1,GF2,GF12,GF3
      COMMON/NOZ/M6,PT6,P6
      COMMON/RES/CF,THRUST,ISP,SFC
      COMMON/CHO/PT5,P5
      COMMON/INI/PT0,TT0
      COMMON/CON/PT1C,M1C,A1C,ALFA
      COMMON/THRO/M11,PT11,M21,PT21,MS1,PTS1
      COMMON/NS/M12,PT12,M22,PT22,MS2,PTS2
      COMMON/DIF/M2,PT2,P2
      COMMON/CHE/M3N,M3I,PT3,PT3M,M4,AS
      REAL M0,M1C,M11,M12,M2,M3N,M3I,M4,M5,M6
      REAL L3,N,ISP,M21,M22,MS1,MS2
      REAL MI1
      AN=A1C*M1C
      G1=1.+GA2*M1C**2
      MI1=M1C
      CALL CALCM(MI1,AN,AI,G1,GA2,GA12)
      IF(ILOO.GT.1)RETURN
      IF(MI1.GE.1.)GO TO(17,18,19),I
      ILOO=10
      IF(IPR.LT.1)RETURN
      PRINT 15,A5AR,A0AR
   15 FORMAT(1X,2F7.3,3X,'UNSTART CONDITIONS')
      IF(IPR.GE.2)CALL PRIN
      RETURN
   17 PT11=PT1C*PID1
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FILE: TRAJET   FORTRAN A   NAVAL POSTGRADUATE SCHOOL

```
      RETURN
   18 PT21=PT1C*PID1*PID2
      RETURN
   19 FAC=(AI-A1)/(A2-A1)
      PID2S=1.-FAC*(1.-PID2)
      PTS1=PT1C*PID1*PID2S
      RETURN
      END

      SUBROUTINE NSR(I,MI1,MI2,PTI1,PTI2)
      COMMON/GEO/AREF,A0,A1,A2,A30,A3,A5,A6,L3,A0AR,A5AR,ILOO,IPR
      COMMON/AIR/GA,GA1,GA2,GA12,GA3,RHOA,T0,P0,U0,M0,GRAV
      COMMON/FUEL/RHOF,ETAT,A,N
      COMMON/LOSS/PID1,PID2,PIB1,PIB2,PIN
      COMMON/BLR/WA,WF,WT,F,ROOT,CSTAR,PT4,TT4
      COMMON/GFI/RF,GF,GF1,GF2,GF12,GF3
      COMMON/NOZ/M6,PT6,P6
      COMMON/RES/CF,THRUST,ISP,SFC
      COMMON/CHO/PT5,P5
      COMMON/INI/PT0,TT0
      COMMON/CON/PT1C,M1C,A1C,ALFA
      COMMON/THRO/M11,PT11,M21,PT21,MS1,PTS1
      COMMON/NS/M12,PT12,M22,PT22,MS2,PTS2
      COMMON/DIF/M2,PT2,P2
      COMMON/CHE/M3N,M3I,PT3,PT3M,M4,AS
      REAL M0,M1C,M11,M12,M2,M3N,M3I,M4,M5,M6
      REAL L3,N,ISP,M21,M22,MS1,MS2
      REAL MI1,MI2
CCC   THIS SECTION COPUTES NORMAL SHOCK RATIO LOSSES
CCC   REF. TO PT12,M12-SHAPIRO VOL1,P.118-119.
      PTI21=PTI1*(GA1*MI1**2/(1.+GA2*MI1**2))**GA3
      PTI22=(GA/GA1*MI1**2-0.5/GA12)**(0.5/GA2)
      PTI2=PTI21/PTI22
      MI2=SQRT((MI1**2+1./GA2)/(2.*GA3*MI1**2-1.))
      RETURN
      END

      SUBROUTINE DIFFUS(I,AI,MI2)
      COMMON/GEO/AREF,A0,A1,A2,A30,A3,A5,A6,L3,A0AR,A5AR,ILOO,IPR
      COMMON/AIR/GA,GA1,GA2,GA12,GA3,RHOA,T0,P0,U0,M0,GRAV
      COMMON/FUEL/RHOF,ETAT,A,N
      COMMON/LOSS/PID1,PID2,PIB1,PIB2,PIN
      COMMON/BLR/WA,WF,WT,F,ROOT,CSTAR,PT4,TT4
      COMMON/GFI/RF,GF,GF1,GF2,GF12,GF3
      COMMON/NOZ/M6,PT6,P6
      COMMON/RES/CF,THRUST,ISP,SFC
      COMMON/CHO/PT5,P5
      COMMON/INI/PT0,TT0
      COMMON/CON/PT1C,M1C,A1C,ALFA
      COMMON/THRO/M11,PT11,M21,PT21,MS1,PTS1
      COMMON/NS/M12,PT12,M22,PT22,MS2,PTS2
      COMMON/DIF/M2,PT2,P2
      COMMON/CHE/M3N,M3I,PT3,PT3M,M4,AS
      REAL M0,M1C,M11,M12,M2,M3N,M3I,M4,M5,M6
      REAL L3,N,ISP,M21,M22,MS1,MS2
      REAL MI2
CCC   THIS SECTION COMPUTES EXPANSION FROM THROAT OF THE INLET
CCC   TO POINT 2
      AN=AI*MI2
      G1=1.+GA2*MI2**2
      M2=MI2
      CALL CALCM(M2,AN,A2,G1,GA2,GA12)
      IF(ILOO.GT.1)RETURN
      GO TO(31,33,33),I
   31 PT2=PT12*PID2
      GO TO 35
   33 FAC=(A2-AI)/(A2-A1)
      PID2S=1.-FAC*(1.-PID2)
      PT2=PTS2*PID2S
   35 P2=PT2*(1.+GA2*M2**2)**(-GA3)
      RETURN
      END
```

```
      SUBROUTINE EXPAN
      COMMON/GEO/AREF,A0,A1,A2,A30,A3,A5,A6,L3,A0AR,A5AR,ILOO,IPR
      COMMON/AIR/GA,GA1,GA2,GA12,GA3,RHOA,T0,P0,U0,M0,GRAV
      COMMON/FUEL/RHOF,ETAT,A,N
      COMMON/LOSS/PID1,PID2,PIB1,PIB2,PIN
      COMMON/BUR/WA,WF,WT,F,ROOT,CSTAR,PT4,TT4
      COMMON/GFI/RF,GF,GF1,GF2,GF12,GF3
      COMMON/NOZ/M6,PT6,P6
      COMMON/RES/CF,THRUST,ISP,SFC
      COMMON/CHO/PT5,P5
      COMMON/INI/PT0,TT0
      COMMON/CON/PT1C,M1C,A1C,ALFA
      COMMON/THRO/M11,PT11,M21,PT21,MS1,PTS1
      COMMON/NS/M12,PT12,M22,PT22,MS2,PTS2
      COMMON/DIF/M2,PT2,P2
      COMMON/CHE/M3N,M3I,PT3,PT3M,M4,AS
      REAL M0,M1C,M11,M12,M2,M3N,M3I,M4,M5,M6
      REAL L3,N,ISP,M21,M22,MS1,MS2
CCC   THIS SUBROUTINE COMPUTES LOSSES DUE TO EXPANSION INTO COMBUSTOR
      BETA=((M2*A2/A3)**2)*(1.+GA2*M2**2)
      M3I=SQRT((SQRT(1.+4.*GA2*BETA)-1.)/(2.*GA2))
      G1=1.+GA2*M2**2
      PT3M=PT2*((1.+GA2*M3I**2)/G1)**GA3
      RETURN
      END

      SUBROUTINE CHECK
      COMMON/GEO/AREF,A0,A1,A2,A30,A3,A5,A6,L3,A0AR,A5AR,ILOO,IPR
      COMMON/AIR/GA,GA1,GA2,GA12,GA3,RHOA,T0,P0,U0,M0,GRAV
      COMMON/FUEL/RHOF,ETAT,A,N
      COMMON/LOSS/PID1,PID2,PIB1,PIB2,PIN
      COMMON/BUR/WA,WF,WT,F,ROOT,CSTAR,PT4,TT4
      COMMON/GFI/RF,GF,GF1,GF2,GF12,GF3
      COMMON/NOZ/M6,PT6,P6
      COMMON/RES/CF,THRUST,ISP,SFC
      COMMON/CHO/PT5,P5
      COMMON/INI/PT0,TT0
      COMMON/CON/PT1C,M1C,A1C,ALFA
      COMMON/THRO/M11,PT11,M21,PT21,MS1,PTS1
      COMMON/NS/M12,PT12,M22,PT22,MS2,PTS2
      COMMON/DIF/M2,PT2,P2
      COMMON/CHE/M3N,M3I,PT3,PT3M,M4,AS
      REAL M0,M1C,M11,M12,M2,M3N,M3I,M4,M5,M6
      REAL L3,N,ISP,M21,M22,MS1,MS2
      IF(PT3M.GE.PT3)RETURN
        ILOO=70
      IF(IPR.LT.1)RETURN
      PRINT 33,A5AR,A0AR
   33 FORMAT(1X,2F7.3,3X,'PT3 IS MORE THAN MAX. VALUE ALLOWED')
      IF(IPR.GE.2)CALL PRIN
      RETURN
      END

      SUBROUTINE HEAT
      COMMON/GEO/AREF,A0,A1,A2,A30,A3,A5,A6,L3,A0AR,A5AR,ILOO,IPR
      COMMON/AIR/GA,GA1,GA2,GA12,GA3,RHOA,T0,P0,U0,M0,GRAV
      COMMON/FUEL/RHOF,ETAT,A,N
      COMMON/LOSS/PID1,PID2,PIB1,PIB2,PIN
      COMMON/BUR/WA,WF,WT,F,ROOT,CSTAR,PT4,TT4
      COMMON/GFI/RF,GF,GF1,GF2,GF12,GF3
      COMMON/NOZ/M6,PT6,P6
      COMMON/RES/CF,THRUST,ISP,SFC
      COMMON/CHO/PT5,P5
      COMMON/INI/PT0,TT0
      COMMON/CON/PT1C,M1C,A1C,ALFA
      COMMON/THRO/M11,PT11,M21,PT21,MS1,PTS1
      COMMON/NS/M12,PT12,M22,PT22,MS2,PTS2
      COMMON/DIF/M2,PT2,P2
      COMMON/CHE/M3N,M3I,PT3,PT3M,M4,AS
      REAL M0,M1C,M11,M12,M2,M3N,M3I,M4,M5,M6
      REAL L3,N,ISP,M21,M22,MS1,MS2
```

```
      REAL M31
      RA=29.314
      M4=0.7
      CALL CALCM(M4,A5,A3,GF1,GF2,GF12)
      I=1
      B=SQRT(TT4/TT0)*(1.+GF*M4**2)/M4*SQRT(GA/GF*RA/RF)*(1.+F)
   70 DEC=B**2-4.*GA
      IF(DEC.LT.0.)GO TO 74
      M3N=(B-SQRT(DEC))/(2*GA)
      IF(I.GT.1)GO TO 72
      M31=M3N
      DEC=(1.+(GA-1)/2.*M31**2)/(1.+(GF-1)/2.*M4**2)
      B=B*SQRT(DEC)
      I=2
      GO TO 70
   72 M3N=(M3N+M31)/2.
      PIB2=(1+(GF-1)/2*M4**2)**(GF/(GF-1))/
     /(1+(GA-1)/2*M3N**2)**(GA/(GA-1))*(1+GA*M3N**2)/(1+GF*M4**2)
      PT3=PT4/PIB2
      RETURN
   74 ILOO=5
      IF(IPR.LT.1)RETURN
      PRINT 75,A5AR,A0AR
   75 FORMAT(1X,2F7.3,5X,'NEGETIVE ARGUMENT FOR M3')
      IF(IPR.GE.2)CALL PRIN
      RETURN
      END

      SUBROUTINE CORVAL
      COMMON/GEO/AREF,A0,A1,A2,A30,A3,A5,A6,L3,A0AR,A5AR,ILOO
      COMMON/AIR/GA,GA1,GA2,GA12,GA3,RHOA,T0,P0,U0,M0,GRAV
      COMMON/FUEL/RHOF,FTAT,A,N
      COMMON/LOSS/PID1,PID2,PIB1,PIB2,PIN
      COMMON/BUR/WA,WF,WT,F,RDOT,CSTAR,PT4,TT4
      COMMON/GFI/RF,GF,GF1,GF2,GF12,GF3
      COMMON/NOZ/M6,PT6,P6
      COMMON/RES/CF,THRUST,ISP,SFC
      COMMON/CHO/PT5,P5
      COMMON/INI/PT0,TT0
      COMMON/CON/PT1C,M1C,A1C,ALFA
      COMMON/THRO/M11,PT11,M21,PT21,MS1,PTS1
      COMMON/NS/M12,PT12,M22,PT22,MS2,PTS2
      COMMON/DIF/M2,PT2,P2
      COMMON/CHF/M3N,M31,PT3,PT3M,M4,AS
      REAL M0,M1C,M11,M12,M2,M3N,M31,M4,M5,M6
      REAL L3,N,ISP,M21,M22,MS1,MS2
CCC   THIS SUBROUTINE CALCULATES CORRECT PLACE OF NORMAL SHOCK
CCC   AND THERFFORE,CORRECT VALUES OF LOSSES AT EVERY STATION
      ASL=A1
      ASR=A2
      IAS=0
   52 AS=(ASL+ASR)/2.
      IAS=IAS+1
      IF(IAS.GT.15)GO TO 58
      CALL THFCAT(3,MS1,AS)
      CALL NSR(3,MS1,MS2,PTS1,PTS2)
      CALL DIFFUS(3,AS,MS2)
      CALL EXPAN
      IF(ILOO.LE.1)GO TO 53
      ILOO=81
      RETURN
   53 DEL=PT3M-PT3
      ADEL=ABS(DEL)/PT3M
      IF(ADEL.LE.0.005)GO TO 55
      IF(DEL)54,55,56
   54 ASR=AS
      GO TO 52
   55 PT11=PTS1
      PT12=PTS2
      M11=MS1
      M12=MS2
      RETURN
```

```
   56 ASL=AS
      GO TO 52
   58 ILOO=82
      IF(IPR.LT.1)RETURN
      PRINT 59,A5AR,AOAR
   59 FORMAT(1X,2F7.3,5X,'DOES NOT FIND CORRECT NORMAL SHOCK')
      IF(IPR.GE.2)CALL PRIN
      RETURN
      END

      SUBROUTINE PRIN
      COMMON/GEO/AREF,AO,A1,A2,A30,A3,A5,A6,L3,AOAR,A5AR,ILOO,IPR
      COMMON/AIR/GA,GA1,GA2,GA12,GA3,RHOA,TO,PO,UO,MO,GRAV
      COMMON/FUEL/RHOF,ETAT,A,N
      COMMON/LOSS/PID1,PID2,PIB1,PIB2,PIN
      COMMON/BUR/WA,WF,WT,F,RDOT,CSTAR,PT4,TT4
      COMMON/GFI/RF,GF,GF1,GF2,GF12,GF3
      COMMON/NOZ/M6,PT6,P6
      COMMON/RES/CF,THRUST,ISP,SFC
      COMMON/CHO/PT5,P5
      COMMON/INI/PTO,TTO
      COMMON/CON/PT1C,M1C,A1C,ALFA
      COMMON/THRO/M11,PT11,M21,PT21,MS1,PTS1
      COMMON/NS/M12,PT12,M22,PT22,MS2,PTS2
      COMMON/DIF/M2,PT2,P2
      COMMON/CHE/M3N,M3I,PT3,PT3M,M4,AS
      REAL MO,M1C,M11,M12,M2,M3N,M3I,M4,M5,M6
      REAL L3,N,ISP,M21,M22,MS1,MS2
      PRINT 110,WA,WF,WT,F,RDOT,CSTAR,PT4
      PRINT 120,M6,PT6,P6
      PRINT 130,CF,THRUST,ISP,SFC
      PRINT 140,PT5,P5,PO
      PRINT 150,PO,TO,PTO,TTO
      PRINT 160,RF,GF,GA,TT4
      PRINT 165,PT1C,M1C,A1C,ALFA
      PRINT 170,M11,PT11,M21,PT21,MS1,PTS1
      PRINT 180,M12,PT12,M22,PT22,MS2,PTS2
      PRINT 190,M2,PT2,P2
      PRINT 200,M3N,M3I,PT3,PT3M,M4,AS
  110 FORMAT(2X,'WA,WF,WT,F,RDOT,CSTAR,PT4=',7E11.4)
  120 FORMAT(2X,'M6,PT6,P6=',3E11.4)
  130 FORMAT(2X,'CF,F,ISP,SFC=',4E11.4)
  140 FORMAT(2X,'PT5,P5,PO=',3E11.4)
  150 FORMAT(2X,'PO,TO,PTO,TTO=',4E11.4)
  160 FORMAT(2X,'RF,GF,GA,TT4=',4E11.4)
  165 FORMAT(2X,'PT1C,M1C,A1C,ALFA=',4E11.4)
  170 FORMAT(2X,'M11,PT11,M21,PT21,MS1,PTS1=',6E11.4)
  180 FORMAT(2X,'M12,PT12,M22,PT22,MS2,PTS2=',6E11.4)
  190 FORMAT(2X,' M2,PT2,P2=',3F11.4)
  200 FORMAT(2X,'M3N,M3I,PT3,PT3M,M4,AS=',6E11.4)
      RETURN
      END

      SUBROUTINE PRILOO(IPRIN)
      COMMON/GEO/AREF,AO,A1,A2,A30,A3,A5,A6,L3,AOAR,A5AR,ILOO,IPR
      COMMON/AIR/GA,GA1,GA2,GA12,GA3,RHOA,TO,PO,UO,MO,GRAV
      COMMON/FUEL/RHOF,ETAT,A,N
      COMMON/LOSS/PID1,PID2,PIB1,PIB2,PIN
      COMMON/BUR/WA,WF,WT,F,RDOT,CSTAR,PT4,TT4
      COMMON/GFI/RF,GF,GF1,GF2,GF12,GF3
      COMMON/NOZ/M6,PT6,P6
      COMMON/RES/CF,THRUST,ISP,SFC
      COMMON/CHO/PT5,P5
      COMMON/INI/PTO,TTO
      COMMON/CON/PT1C,M1C,A1C,ALFA
      COMMON/THRO/M11,PT11,M21,PT21,MS1,PTS1
      COMMON/NS/M12,PT12,M22,PT22,MS2,PTS2
      COMMON/DIF/M2,PT2,P2
      COMMON/CHE/M3N,M3I,PT3,PT3M,M4,AS
      COMMON/TRA/PI,MUA,DRAG,RPR,LPR,WPR,U,WB,DELU,DELT,TI,TETA,IRAM,
     ,IL,ILO,Y,YO,TOB,X1,Y1,X2,Y2,X3,Y3,WPRB,R,TOR3,ITRA,TETAOD,XOB,YOB
      COMMON/ORG/TETP,CDN,CFT,CDWW,CDWF,APR,SPR,SWW,Q,XMO
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```
      REAL M0,M1C,M11,M12,M2,M3N,M3I,M4,M5,M6
      REAL L3,N,ISP,M21,M22,MS1,MS2,MUA,LPR
      A0AR=A0/AREF
      A1CA0=A1C/A0
      A1A0=A1/A0
      A2A0=A2/A0
      A3AR=A3/AREF
      A5AR=A5/AREF
      A6A5=A6/A5
      A5A0=A5/A0
      P1CP0=PT1C/PT0
      P11P1C=PT11/PT1C
      P12P11=PT12/PT11
      P2P12=PT2/PT12
      P3P2=PT3M/PT2
      P3MP3=PT3M/PT3
      P4P3=PT4/PT3
      P6P4=PT6/PT4
      P6P0=PT6/PT0
      WFWA=F*100.
      IF(IPRIN.GT.2)GO TO 77
      IPRIN=7
      PRINT 210
      PRINT 212
      PRINT 214
      PRINT 216
      PRINT 218
      PRINT 220
      PRINT 222,AREF,L3,TETP
      PRINT 224
      PRINT 226,A0AR,A1CA0,A1A0,A2A0,A3AR,A5AR,A6A5
      PRINT 232
      PRINT 234,M0,M1C,M6
      PRINT 236
      PRINT 238,PID1,PID2,PIN
      PRINT 244
      PRINT 246
      PRINT 248,P0,T0,RHOA,PT0,TT0,GA
      PRINT 250
      PRINT 252
   77 CONTINUE
      PRINT 256,TI,M0,A5A0,WA,WFWA,M2,M3N,M3I,M4,
     *P1CP0,P12P11,P3P2,P4P3,P6P0,
     *GF,TT4,CF,THRUST,ISP
  210 FORMAT(1H1,40X,'CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC')
  212 FORMAT(41X,'CCC                          CCC')
  214 FORMAT(41X,'CCC   SOLID FUEL RAMJET      CCC')
  216 FORMAT(41X,'CCC                          CCC')
  218 FORMAT(41X,'CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC'///)
  220 FORMAT(5X,'GEOMETRICAL DATA:'//)
  222 FORMAT(8X,'AREF=',E11.4,'M2',3X,'L3=',E11.4,'M',5X,'TETP=',F5.1//)
  224 FORMAT(10X,'A0/AREF',3X,'A1C/A0',3X,'A1/A0',5X,'A2/A0',
     *5X,'A3/AREF',4X,'A5/AREF',4X,'A6/A5'/)
  226 FORMAT(6X,7F10.4///)
  232 FORMAT(10X,'M0',8X,'M1C',7X,'M6'/)
  234 FORMAT(6X,3F10.4///)
  236 FORMAT(5X,'CONSTANT LOSSES:'/)
  238 FORMAT(8X,'PID1=',F7.3,5X,'PID2=',F7.3,5X,'PIN=',F7.3//)
  244 FORMAT(5X,'INITIAL FLIGHT CONDITIONS:'//)
  246 FORMAT(10X,'P0(KG/M2)',2X,'T0(K)',6X,'ROO(KG/M3)',1X,
     *'PT0(KG/M2)',1X,'TT0(K)',8X,'GA'/)
  248 FORMAT(8X,5E11.3,F10.3///)
  250 FORMAT(3X,'TIME',2X,'M0',3X,'A5/A0',1X,'WA',4X,'WF/WA',1X,
     *'M2',4X,'M3N',3X,'M3I',3X,'M4',7X,'TOTAL PRES. RATIOS')
  252 FORMAT(56X,'1C/0',2X,'12/11',2X,'3/2',3X,
     *'4/3',2X,'6/0',3X,'GF',3X,'TT4(K)',1X,
     *'CF',4X,'F(N)',3X,'ISP'/)
  256 FORMAT(1X,F7.2,F5.2,12F6.3,F5.2,F7.1,F6.3,F7.1,F7.1)
      RETURN
      END

      SUBROUTINE TRAJ
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FILE: TRAJET   FORTRAN A   NAVAL POSTGRADUATE SCHOOL

```
      COMMON/TRA/PI,MUA,DRAG,RPR,LPR,WPR,U,WB,DELU,DELT,TI,TETA,IRAM,
     ,IL,ILO,Y,YO,TOB,X1,Y1,X2,Y2,X3,Y3,WPRB,R,TORB,ITRA,TETAOD,XOB,YOB
      COMMON/GEO/AREF,A0,A1,A2,A30,A3,A5,A6,L3,A0AR,A5AR,ILOO,IPR
      COMMON/AIR/GA,GA1,GA2,GA12,GA3,RHOA,TO,PO,UO,MO,GRAV
      COMMON/BLR/WA,WF,WT,F,ROOT,CSTAR,PT4,TT4
      COMMON/RES/CF,THRUST,ISP,SFC
      COMMON/CCN/PT1C,M1C,A1C,ALFA
      COMMON/DRG/TETP,CDN,CFT,CDWW,CDWF,APR,SPR,SWW,Q,XMO
      REAL MO,LPR,L3,MUA,ISP,M1C
      AITRA=ITRA
      AITRA=ABS(AITRA)
      IF(AITRA.GT.1.)GO TO 23
      IF(ITRA.GT.0)ITRA=2
      IF(ITRA.LT.0)ITRA=-2
      TI=0.
      YO=0.
      Y=YO
      TETA0=TETAOD*PI/180.
      TETA=TETA0
CCC   VACUUM TIME OF FLIGHT(TOFV):
      TOFV=2.*U*SIN(TETA)/GRAV
      ILO=4
      DELT=TOFV/50./ILO
      IF(ITRA.LT.0)GO TO 125
      WRITE(2,131)
      WRITE(3,131)
  131 FORMAT(1H1///,40X,'RAMJET TRAJECTORY'///)
      WRITE(3,132)
  132 FORMAT(43X,'(DRAG COEF.)'///)
      WRITE(2,133)
      WRITE(3,133)
  133 FORMAT(4X,'LPR',7X,'WPR',7X,'A30',7X,'A0/AR',5X,'A5/AR',5X,'L3',
     ,8X,'UO',8X,'U',9X,'WB',8X,'TOFV'/)
      WRITE(2,135)LPR,WPR,A30,A0AR,A5AR,L3,UO,U,WB,TOFV
      WRITE(3,135)LPR,WPR,A30,A0AR,A5AR,L3,UO,U,WB,TOFV
  135 FORMAT(2X,10F10.3///)
      WRITE(2,137)
  137 FORMAT(4X,'TI',8X,'X3',8X,'Y3',8X,'TETA',6X,'MO',4X,'PO',8X,
     ,'RHOA',6X,'TO',8X,'MUA',7X,'WPR',3X,'DRAG',2X,'THRUST'/)
      WRITE(3,140)
  140 FORMAT(4X,'TETP',6X,'CDN',7X,'CDS',7X,'CDWW',6X,'CDWF',6X,
     ,'APR',7X,'SPR',7X,'SWW',7X,'Q',9X,'XMO'/)
  125 IL=ILO
      X1=0.
      Y1=YO
      X2=U*COS(TETA)*DELT
      Y2=U*SIN(TETA)*DELT
   23 CALL ATM
      MO=U/SQRT(GA*GRAV*R*TO)
C
C        AIR DEFENCE CASE:DO NOT LET MO BE TOO SMALL,TO ALLOW MANUVERING
C
         IF(IRAM.GT.1)GO TO 138
         IF(MO.LT.XMO)GO TO 29
  138 CALL DRAGG
      IF(ILOO.GT.1)RETURN
C     IF YOU WANT DRAG=0 OR THRUST=DRAG CASE,SPECIFY THAT HERE.
C
      CALL DYNA
      Y=Y3/0.3048
      TETD=TETA*180./PI
      IF(Y3.LE.YO)IL=ILO
      IF(IL.LT.ILO)GO TO 28
      IL=0
      IF(ITRA.LT.0)GO TO 127
      WRITE(2,139)TI,X3,Y3,TETD,MO,PO,RHOA,TO,MUA,WPR,DRAG,THRUST
  139 FORMAT(1X,4E10.3,F6.3,4E10.3,3F7.1)
      WRITE(3,141)TETP,CDN,CFT,CDWW,CDWF,APR,SPR,SWW,Q,XMO
  141 FORMAT(1X,F5.2,5X,8E10.3,2X,F5.2)
  127 IF(Y3.LE.YO)GO TO 29
   28 IL=IL+1
      RETURN
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```
   29 IF(TORB.GT.0.001)GO TO 30
        TORB=TI-DELT
        XOB=X3
        YOB=Y3
        IF(IRAM.NE.1)GO TO 30
        IRAM=2
        GO TO 138
   30 IF(ITRA.LT.0) GO TO 31
      PRINT 146,TETAOD,TORB,XOB,YOB
  146 FORMAT(1X,///,10X,'TETA=',F5.1,7X,'TIME OF BURNING=',
     ,F6.2,1X,'SEC',7X,'RANGE OF BURNING=',F10.4,1X,'KM',7X,
     ,'HEIGHT OF BURNING=',F10.4,1X,'KM')
      STOP
   31 PRINT 148,A0AR,A5AR,TORB,XOB,YOB,TI,X3,Y3,TETP,TETAOD
  148 FORMAT(2X,10F11.3)
      ILOO=20
      RETURN
      END

      SUBROUTINE ATM
      COMMON/TRA/PI,MUA,DRAG,RPR,LPR,WPR,U,WB,DELU,DELT,TI,TETA,IRAM,
     ,IL,ILO,Y,YO,TOB,X1,Y1,X2,Y2,X3,Y3,WPRB,R,TORB,ITRA,TETAOD,XOB,YOB
      COMMON/GEO/AREF,A0,A1,A2,A30,A3,A5,A6,L3,A0AR,A5AR,ILOO,IPR
      COMMON/AIR/GA,GA1,GA2,GA12,GA3,RHOA,TO,PO,UO,MO,GRAV
      REAL MO,LPR,L3,MUA,ISP,MIC
CCC   ATMOSPHERIC FORMULA FOR PRESSURE,DENSITY,TEMPRATURE,VISCOSITY
CCC   UNITS IN KG/M2,KG/M3,DEG.K,KG/M.SEC RESP.;HEIGHT(Y).IN FT.
      PO=1.03322E04*EXP(-16.2E-06*Y**1.09)
      RHOA=1.224845*EXP(-7.4E-06*Y**1.15)
      IF(Y.GE.36089)GO TO 25
      TO=288.16*EXP(-3.70734E-06*Y**1.0709)
      MUA=1.793E-05*EXP(-15.523E-06*Y**0.8984)
      GO TO 27
   25 TO=217.24
      MUA=1.4124E-05
   27 CONTINUE
      RETURN
      END

      SUBROUTINE BOOS
      COMMON/TRA/PI,MUA,DRAG,RPR,LPR,WPR,U,WB,DELU,DELT,TI,TETA,IRAM,
     ,IL,ILO,Y,YO,TOB,X1,Y1,X2,Y2,X3,Y3,WPRB,R,TORB,ITRA,TETAOD,XOB,YOB
      COMMON/GEO/AREF,A0,A1,A2,A30,A3,A5,A6,L3,A0AR,A5AR,ILOO,IPR
      COMMON/AIR/GA,GA1,GA2,GA12,GA3,RHOA,TO,PO,UO,MO,GRAV
      COMMON/BLR/WA,WF,WT,F,ROOT,CSTAR,PT4,TT4
      COMMON/RES/CF,THRUST,ISP,SFC
      COMMON/CCN/PT1C,MIC,A1C,ALFA
      REAL MO,LPR,L3,MUA,ISP,MIC
      RHOB=1.65E03
      ISPB=240
      VB=(A30-A5)*L3
      WB=VB*RHOB
      UEQ=ISPB*GRAV
      DELU=UEQ*ALOG(WPR/(WPR-WB))
      RETURN
      END

      SUBROUTINE DRAGG
      COMMON/TRA/PI,MUA,DRAG,RPR,LPR,WPR,U,WB,DELU,DELT,TI,TETA,IRAM,
     ,IL,ILO,Y,YO,TOB,X1,Y1,X2,Y2,X3,Y3,WPRB,R,TORB,ITRA,TETAOD,XOB,YOB
      COMMON/GEO/AREF,A0,A1,A2,A30,A3,A5,A6,L3,A0AR,A5AR,ILOO,IPR
      COMMON/AIR/GA,GA1,GA2,GA12,GA3,RHOA,TO,PO,UO,MO,GRAV
      COMMON/BLR/WA,WF,WT,F,ROOT,CSTAR,PT4,TT4
      COMMON/RES/CF,THRUST,ISP,SFC
      COMMON/CCN/PT1C,MIC,A1C,ALFA
      COMMON/DRG/TETP,CON,LET,COWW,COWF,APR,SPR,SWW,Q,XMO
      REAL MO,LPR,L3,MUA,ISP,MIC
        IF(IRAM.GE.1)GO TO 50
      CALL DRAGN(TETP,[illegible],CON)
      IF(ILOO.LE.1)GO TO 45
      ILOO=22
      RETURN
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```
   45 CALL DRAGWW(MO,GA,BWING,CWING,CDWW)
      CALL CALCD(LPR,CFT)
      CALL CALCD(CWING,CDWF)
      APR=PI*RPR**2
      SPR=2*PI*RPR*LPR
      SWW=8*BWING*CWING
      Q=0.5*RHOA*U**2
      DRAG=Q*(APR*CON+SPR*CFT+SWW*(CDWW+CDWF))
      RETURN
   50    CALL  DRAGPR
         RETURN
      END

      SUBROUTINE DRAGPR
      COMMON/TRA/PI,MUA,DRAG,RPR,LPR,WPR,U,WB,DELU,DELT,TI,TETA,IRAM,
     .IL,ILO,Y,YO,TOB,X1,Y1,X2,Y2,X3,Y3,WPRB,R,TORB,ITRA,TETAOD,XCB,YOB
      COMMON/GEO/AREF,A0,A1,A2,A30,A3,A5,A6,L3,A0AR,A5AR,ILOO,IPR
      COMMON/AIR/GA,GA1,GA2,GA12,GA3,RHOA,TO,PO,UO,MO,GRAV
      COMMON/BUR/WA,WF,WT,F,RDOT,CSTAR,PT4,TT4
      COMMON/RES/CF,THRUST,ISP,SFC
      COMMON/CON/PT1C,M1C,A1C,ALFA
      COMMON/DRG/TETP,CON,CFT,CDWW,CDWF,APR,SPR,SWW,Q,XMO
      REAL MO,LPR,L3,MUA,ISP,M1C
         CDWW=0.
         CDWF=0.
         CDN=(0.083+0.096/MO**2)*(ALFA/10.)**1.69
         CDB=(0.6837-0.3165*MO+0.0525*MO**2)*(2./PI)
         CALL  CALCD(LPR,CFT)
         APR=PI*RPR**2
         SPR=2.*PI*RPR*LPR
         Q=0.5*RHOA*U**2
         DRAG=Q*(APR*(CDN+CDB)+SPR*CFT)
         RETURN
         END

      SUBROUTINE DRAGN(TETP,XM,CON)
      COMMON/GEO/AREF,A0,A1,A2,A30,A3,A5,A6,L3,A0AR,A5AR,ILOO,IPR
       IF(XM.GE.1.5)GO TO 13
       CON=(0.083+0.096/XM**2)*1.21
C      AT(MO.LT.1.5) PROGRAM COWL,WHICH CALCULATES CON,DOES NOT WORK.
C      THE APPROXIMATE VALUE HERE FITS AT THE BOUNDARY.
C      THE APPROX. IS EXCEPTED BECAUSE DRAG IS SMALL ANYHOW.
       RETURN
   13 CALL INTER(4,TETP,XM,CON)
      RETURN
      END

      SUBROUTINE DRAGWW(XM,GA,BWING,CWING,CDWW)
      PI=4.*ATAN(1.)
      RADEG=PI/180.
      DATA T,C/5./,DREF/5./,B/0.09525/,C/0.0635/,T/0.01/
      AREF=PI*(DREF*0.0254)**2/4.
         BWING=B
         CWING=C
CC       ALL LENGTHS IN METERS.
      IF(XM.GE.1.25)GO TO 13
      CDWW=0.017
C         THE SUBROUTINE DOES NOT WORK AT(MO.LT.1.25)
C         THE APPROX. IS EXCEPTED BECAUSE DRAG IS SMALL ANYHOW.
      RETURN
   13 TW=TWO*RADEG
      XM1=XM
      XM2=XM
      CALL PRANT(XM,GA,ANI0)
      ANI1=ANI0-TW
      ANI2=ANI0+TW
      CALL PRES(XM,GA,P0PT)
      CALL APRANT(XM1,GA,ANI1)
      CALL PRES(XM1,GA,P1PT)
      CALL APRANT(XM2,GA,ANI2)
      CALL,PRES(XM2,GA,P2PT)
C
```

```
      BP=B-C/2/SQRT(XM**2-1)
      CDWW=(2./(GA*XM**2))*(P1PT/POPT-P2PT/POPT)*(T*BP/AREF)
      RETURN
      END

      SUBROUTINE PRANT(XMI,GA,ANI)
      BETA=SQRT(XMI**2-1.)
      GARAT=SQRT((GA-1.)/(GA+1.))
      ANI=ATAN(GARAT*BETA)/GARAT-ATAN(BETA)
      RETURN
      END

      SUBROUTINE APRANT(XMI,GA,ANI)
      IF(XMI.LE.1.0)GO TO 558
      IF(ANI.LT.0.0)GO TO 558
      BETA=SQRT(XMI**2-1.)
      GARAT=SQRT((GA-1.)/(GA+1.))
      IBETA=0
  552 F=ATAN(GARAT*BETA)/GARAT-ATAN(BETA)-ANI
      FP=1./(1.+(GARAT*BETA)**2)-1./(1.+BETA**2)
      IBETA=IBETA+1
      IF(IBETA.GT.12)GO TO 558
      IF(FP.EQ.0.0)GO TO 558
      BETAN=BETA-F/FP
      IF((ABS(BETAN-BETA)).LE.(1.E-05))GO TO 556
      BETA=ABS(BETAN)
      GO TO 552
  556 XMI=SQRT(BETA**2+1.)
      RETURN
  558 PRINT 560,IBETA,ANI,F,FP,BETA
  560 FORMAT(' ','STOP FROM 560',I3,4(2X,E11.4))
      STOP
      END

      SUBROUTINE PRES(XMI,GA,P1PT)
      P1PT=(1.+(GA-1.)/2.*XMI**2)**(-GA/(GA-1.))
      RETURN
      END

      SUBROUTINE CALCD(XL,X)
      COMMON/TRA/PI,MUA,DRAG,RPR,LPR,WPR,U,WB,DELU,DELT,TI,TETA,IRAM,
     ,IL,ILO,Y,YO,TOB,X1,Y1,X2,Y2,X3,Y3,WPRB,R,TORB,ITRA,TETAOO,XCB,YOB
      COMMON/GEO/AREF,A0,A1,A2,A30,A3,A5,A6,L3,A0AR,A5AR,ILOO,IPR
      COMMON/AIR/GA,GA1,GA2,GA12,GA3,RHOA,TO,PO,UO,MO,GRAV
      COMMON/BLR/WA,WF,WT,F,PDOT,CSTAR,PT4,TT4
      COMMON/RES/CF,THRUST,ISP,SFC
      COMMON/CON/PT1C,M1C,A1C,ALFA
      REAL MO,LPR,L3,MUA,ISP,M1C
      E=EXP(1.)
      IX=0
      EPS=1.E-07
      X=2.E-03
      REL=RHOA*U*XL/MUA
      IF(REL.LE.2.0E06)GO TO 8
    7 FX=SQRT(X)*ALOG10(X*REL)-0.242
      FXDOT=1.0/SQRT(X)*(ALOG10(SQRT(X*REL)*E))
      XNEW=X-FX/FXDOT
      DIF=ABS(X-XNEW)
      IF(DIF.LE.EPS)RETURN
      X=XNEW
      IX=IX+1
      IF(IX.GT.13)GO TO 9
      GO TO 7
    8 X=1.328/SQRT(REL)
      RETURN
    9 ILOO=20
      PRINT 11,X,DIF
   11 FORMAT(5X,'DO NOT FIND A SOLUTION TO CFT: X=',E10.3,5X,'DIF=',
     ,E10.3)
      STOP
      END
```

```
      SUBROUTINE DYNA
      COMMON/TRA/PI,MUA,DRAG,RPR,LPR,WPR,U,WB,DELU,DELT,TI,TETA,IRAM,
     ,IL,ILO,Y,YO,TOB,X1,Y1,X2,Y2,X3,Y3,WPRB,R,TORB,ITRA,TETAOD,XOB,YOB
      COMMON/GEO/AREF,AO,A1,A2,A30,A3,A5,A6,L3,AOAR,A5AR,ILOO,IPR
      COMMON/AIR/GA,GA1,GA2,GA12,GA3,RHOA,TO,PO,UO,MO,GRAV
      COMMON/BLR/WA,WF,WT,F,RDOT,CSTAR,PT4,TT4
      COMMON/RES/CF,THRUST,ISP,SFC
      COMMON/CON/PTIC,MIC,AIC,ALFA
      REAL MO,LPR,L3,MUA,ISP,MIC
      X3=(THRUST-DRAG)*COS(TETA)*DELT**2/WPR+2*X2-X1
      Y3=(-GRAV+((THRUST-DRAG)*SIN(TETA))/WPR)*DELT**2+2*Y2-Y1
CCC   DATA FOR NEXT LOOP:
      TI=TI+DELT
      TETA=ATAN((Y3-Y2)/(X3-X2))
      UX=(X3-X2)/DELT
      UY=(Y3-Y2)/DELT
      U=SQRT(UX**2+UY**2)
      X1=X2
      Y1=Y2
      X2=X3
      Y2=Y3
      RETURN
      END

      SUBROUTINE DATTA
      COMMON/GEO/AREF,AO,A1,A2,A30,A3,A5,A6,L3,AOAR,A5AR,ILOO,IPR
     ,,A1A0,A2A0,A6A5,A3AR
      COMMON/AIR/GA,GA1,GA2,GA12,GA3,RHOA,TO,PO,UO,MO,GRAV
      COMMON/FUEL/RHOF,ETAT,A,N
      COMMON/LOSS/PID1,PID2,PIB1,PIB2,PIN
      COMMON/BLR/WA,WF,WT,F,RDOT,CSTAR,PT4,TT4
      COMMON/GFT/RF,GF,GF1,GF2,GF12,GF3
      COMMON/NOZ/M6,PT6,P6
      COMMON/RES/CF,THRUST,ISP,SFC
      COMMON/CHO/PT5,P5
      COMMON/INI/PTO,TTO
      COMMON/CON/PTIC,MIC,AIC,ALFA
      COMMON/THRO/M11,PT11,M21,PT21,MS1,PTS1
      COMMON/NS/M12,PT12,M22,PT22,MS2,PTS2
      COMMON/DIF/M2,PT2,P2
      COMMON/CHE/M3N,M3I,PT3,PT3M,M4,AS
      COMMON/TRA/PI,MUA,DRAG,RPR,LPR,WPR,U,WB,DELU,DELT,TI,TETA,IRAM,
     ,IL,ILO,Y,YO,TOB,X1,Y1,X2,Y2,X3,Y3,WPRB,R,TORB,ITRA,TETAOD,XOB,YOB
      COMMON/DRG/TETP,CDN,CFT,CDWW,CDWF,APR,SPR,SWW,Q,XMO
      REAL MO,MIC,M11,M12,M2,M3N,M3I,M4,M5,M6
      REAL L3,N,ISP,M21,M22,MS1,MS2,MUA,LPR
CCC   GEOMETRICAL DATA:
CCC    -INCHES OR SQ. INCHES(ORIGINAL)
CCC    -REF:BROWN P.17 OR CSD P.13
CCC      LOSSES
CCC   PID1=B.L.,PID2=SUBSONIC DIF.RECOVERY,
CCC   PIN=NOZZLE LOSSES
CCC      IPR,FOR DETALED PRINTINGS:=0 CLEAN RAM+TRAJ:=1 NO PRIN:
CCC   =2 ALSO PRIN:=3 ALSO LOOP ON MACH.: =-1 TRAJ.ONLY.
CCC      ITRA,FOR TRAJECTORY & LOOP ON AREAS
CCC   =+1 WILL WORK ON ONE POINT:=-1 WILL LOOP & PRINT ONLY SUMMARY
CCC      ILOO=2 BURN:=3 NOZZ:=4 CHOKE:=5 HEAT:=6 INLET(61 MIN.
CCC   62 THROAT,63 DIFFUS):=7 CHECK:=8 CORVAL(81 EXPAN,82 IAS.GT.15):
CCC   =9 RESUL:=20 TRAJ(22 DRAGN).
CCC      XMO=MIN. MACH NUMBER ALLOWED.
CCC      IRAM=0 RAMJET:=1 PROJECTILE.
      AREF=19.3*.0254**2
      READ (5,*) AOAR,A5AR,A1A0,A2A0,A3AR
      READ (5,*) ALFA,TETAOD,TETP
      READ (5,*) IPR,ITRA,XMO,IRAM
      READ (5,*) PID1,PID2,PIN
      AO=AOAR*AREF
      A1=AO*A1A0
      A2=AO*A2A0
      A30=AREF*A3AR
      A3=A30
      A5=A5AR*AREF
```

```
      A6=AREF
      RPR=2.5*0.0254
      LPR=60.97*0.0254
      WPR=104.7*0.45359
      PI=3.1415926
      L3=23.*.0254
CCC   AIR FLOW
      GA=1.4
CCC   RHOA IN KG/M3,TO IN DEG. KELVIN,PO IN ATM. ARE GIVEN FROM TRAJ
CCC   FUEL=HTPB
      ETAT=0.9
CCC   DATA FOR ROOT=A*WAA3**N,IN/SEC
      A=0.06
      N=0.6
      RHOF=0.0351
CCC   RHOF IN LB/IN3,=972 KG/M3
      RHOF=RHOF*.45359/(2.54/100)**3
CCC   FLIGHT CONDITIONS:
CCC   UO IN FT/SEC:1FT.=30.48CM
      UO=2500.
      UO=UO*.3048
      GRAV=9.807
CCC   GRAV IN M/SEC2 . R=PERFECT GAS CONSTANT(FOR AIR).
      R=29.314
      RETURN
      END
```

APPENDIX E: COMPUTER PROGRAM LIST OF SYMBOLS

PROGRAM SYMBOL	EQUATIONS SYMBOL	UNITS	MEANING
			GEOMETRICAL SYMBOLS
AREF	A_r	m^2	Reference area
AJ	A_j	m^2	Area at station j
AIC	A_{1c}	m^2	Area behind a conical shock wave
AJ1*	A_{j1}	m^2	Area ahead of a normal shock wave
AJ2*	A_{j2}	m^2	Area behind a normal shock wave
A30	A_{30}	m^2	Initial area at station 3
AIAJ	A_i/A_j	-	Area ratios
L3	L_3	m	Length of combustion chamber
LPR	L_p	m	Length of projectile
RPR	R_p	m	Radius of projectile
ALFA	α	deg.	Inlet cone half angle

*When: J=1,2.S, the shock wave is at station 1 2 real case, respectively.

PROGRAM SYMBOL	EQUATIONS SYMBOL	UNITS	MEANING
		ATMOSPHERIC SYMBOLS	
TO	T_0	^oK	Static temperature at altitude y_3
P O	p_0	kg/m^2	Static pressure at altitude y_3
RHOA	ρ_0	kg/m^3	Air density at altitude y_3
MUA	μ_0	$N.sec/m^2$	Air viscosity at altitude y_3
UO	U_0	m/sec	Projectile muzzle velocity
MO	M_0	-	Projectile initial mach number
GRAV	g	m/sec^2	Gravity (9.807)
GA	γ_a	-	Air heat capacities ratio (c_p/c_v)
GA1	-	-	$(\gamma_a+1)/2$
GA2	-	-	$(\gamma_a-1)/2$
GA12	-	-	$(\gamma_a+1)/[2(\gamma_a-1)]$
GA3	-	-	$\gamma_a/(\gamma_a-1)$

PROGRAM SYMBOL	EQUATIONS SYMBOL	UNITS	MEANING
			COMBUSTION CHAMBER'S SYMBOLS
RHOF	ρ_f	kg/m^3	Fuel density
ETAT	η_T	-	Burning efficiency
A,N	A,N	-	Burning rate parameters
WA	$\dot{w}_a$	kg/sec	Air mass flow
WF	$\dot{w}_f$	kg/sec	Fuel mass flow
WT	$\dot{w}_T$	kg/sec	Total mass flow
F	F	-	$\dot{w}_f/\dot{w}_a$
RDOT	$\dot{r}$	m/sec	Burning rate
CSTAR	C*	m/sec	$\sqrt{g_* R_f * T_{T4}}$ / Γ(when: $\Gamma = \Gamma(\gamma_f)$).
RF	R_f	$m/^oK$	Hot gas constant $\left[= \frac{R(j/mole/^oK)}{MW(kg/mole)*g(m/sec^2}\right.$
GF	γ_f	-	Hot gas heat capacities ratio (c_p/c_v)
GF1	-	-	$(\gamma_f+1)/2$
GF2	-	-	$(\gamma_f-1)/2$
GF12	-	-	$(\gamma_f+1)/[2(\gamma_f-1)]$
GF3	-	-	$\gamma_f/(\gamma_f-1)$

PROGRAM SYMBOL	EQUATIONS SYMBOL	UNITS	MEANING
		THERMODYNAMIC SYMBOLS	
TJ	T_j	^oK	Static temperature at station j
TTJ	T_{Tj}	^0K	Total temperature at station j
PJ	p_j	kg/m^2	Static pressure at station j
PTJ	p_{Tj}	kg/m^2	Total pressure at station j
MJ	M_j	-	Mach number at station j
PTJ1, PTJ2	p_{Tj1}, p_{Tj2}		As above with AJ1, AJ2
MJ1, MJ2	M_{j1}, M_{j1}		
T3M	T3M	kg/m^2	Maximum T3 available
M3N, M3I	M_{3N}, M_{3I}	-	M_3 calculated from nozzle and inlet direction, respectively.

PROGRAM SYMBOL	EQUATIONS SYMBOL	UNITS	MEANING
			LOSSES SYMBOLS
PID1	π_D'	-	Boundary layer losses
PID2	π_D''	-	Subsonic diffuser recovery
PIN	π_n	-	Nozzle losses
-	π_C	-	Conical wave losses
-	π_{NS}	-	Normal shock losses
-	π_e	-	Expansion losses
-	π_h	-	Heat losses

PROGRAM SYMBOL	EQUATIONS SYMBOL	UNITS	MEANING
		RAMJET PERFORMANCE SYMBOLS	
CF	C_f	-	Thrust coefficient
Thrust	F	N (or kg)	Thrust
ISP	I_{sp}	N/kg.sec (or sec)	Fuel specific impulse
SFC	SFC	kg/hour/N	Specific fuel consumption

PROGRAM SYMBOL	EQUATIONS SYMBOL	UNITS	MEANING
		TRAJECTORY SYMBOLS	
Drag	D	N	Drag
WPR	W_p	kg	Mass of projectile
WB	W_B	kg	Mass of booster
DELU	ΔU	m/sec	Change in initial velocity due to booster
U	U	m/sec	$U_0 + \Delta U$
DELT	ΔT	sec	Change in time
TI	t	sec	Time
TOB	t_{OB}	sec	Time of burning
TETA	θ	deg.	Gun elevation angle
TETP	θ_p	deg.	Projectile second cowl angle
		DRAG COEFFICIENT	
CDN	C_{DN}	-	Nose drag coefficient
CDWW	C_{DWW}	-	Wing wave drag coefficient
CDWF	C_{DWF}	-	Wing friction drag coefficient
CDS	C_{DS}	-	Skin drag coefficient (laminar/turbulent)
CDB	C_{DB}	-	Base drag coefficient

PROGRAM SYMBOL	EQUATIONS SYMBOL	UNITS	MEANING
			MATHEMATICAL SYMBOLS
PI	π	-	3.14159
IPR	-	-	Printing parameter: $\geq$ 0 combustion results together with trajectory (on different files): = 0 working results only; = 1 also reasons for not running = 2 also full reasons for not running = 3 also loop on mach number (CALCM) = -1 trajectory prints only
ITRA	-	-	Loop paramerer: = +1 single value for A_0/A_r, A_5/A_r = -1 loop on A_0/A_r, A_5/A_r, and print summary, only.
ILOO	-	-	Check parameter: < 1 regular run $\geq$ 1 doesn't have a solution
IL, ILO	-	-	Trajectory printing parameter (prints every ILO point).
IRAM	-	-	Ramjet parameter: = 0 ramjet in operation = 1 projectile without propulsion
XMO	X_{MO}	-	Stopping mach number

PROGRAM SYMBOL	EQUATIONS SYMBOL	MEANING
		SUBROUTINES
INIT	-	Computes initial conditions
BURN	-	Computes combustion chamber's performance
TERMO	-	Thermodynamic comand subroutine
INTER	-	Computes, by interpulation, thermodynaic conditions, or cowl drag coefficients.
NOZZ	-	Computes nozzle performance
CALCM	-	Computes mach number indirectly
RESUL	-	Computes ramjet performance
CHOKE	-	Checks if nozzle is choked
INLET	-	Command subroutine for inlet
CONE	-	Computes conical wave loss
THROAT	-	Computes boundary layer loss
NSR	-	Computes normal shock loss
DIFFUS	-	Computes subsonic diffuser performance
MIN	-	Command subroutine to compute situation when normal shock is at point 2
CORVAL	-	Command subroutine to compute situation when normal shock is at the correct place
EXPAN	-	Computes losses due to expansion into the combustion chamber
HEAT	-	Computes heat losses at combustion chamber
CHECK	-	Check for pressure capability
TRAJ	-	Command subroutine to compute trajectory
ATM	-	Computes atmospheric conditions as a function of altitude (y)

PROGRAM SYMBOL	EQUATIONS SYMBOL	MEANING
BOOS	-	Computes booster performance
DRAGG	-	Computes drag
CALCD	-	Computes skin drag coefficient, indirectly
DRAGN	-	Cowl drag command subroutine
DRAGWW	-	Computes wing/fin wave drag coefficient (command subroutine)
PRANT	-	Computes Prandtl-Meyer angle (ν) from a given mach number
APRANT	-	Computes mach number from a given Prandtl-Meyer angle (ν)
PRES	-	Pressure ratios formula
DRAGPR	-	Computes drag coefficients of a projectile without combustion
DYNA	-	Computes the dynamics of the projectile
DATTA	-	Initial data
PRILOO	-	Prints ramjet performance
PRIN	-	Prints detailed values when does not fine solution

F1. Input Data

A0AR, A5AR, A1A0, A2A0, A3AR

ALFA, TETA, TETP

IPR, ITRA, XM0, IRAM

PID1, PID2, PIN

Options

ALFA = Inlet cone half angle

TETA = Gun elevation angle

TETP = Second cowl angle

IRP = 0 clean print of RAM + TRAJ

= 1, 2, 3 more details on RAM

= -1 TRAJ only

ITRA = 1 works on one set of data

= -1 loop on A0&A5

IRAM = 0 Ramjet

= 1 Projectile without propulsion

F2. Execution Commands (For use with IBM 370)

F2.1 Opening Commands

```
L△XXXXP
Password
```

```
GLOBAL TXTLIB FORTMOD2 MOD2EEH
```

F2.2 Compilation

```
FORTGI TRAJET
```

F2.3 Run on Terminal

```
FILEDEF  02  DISK  TRJ  D(RECFM F BLOCK 132 PERM
FILEDEF  03  DISK  DRG  D(RECFM F BLOCK 132 PERM
```

```
FILEDEF  05  DISK  INP  D

FILEDEF  06  DISK  CMB  D

EXEC  RUN  TRAJET

XEDIT  CMB  D

(or: XEDIT  TRJ  D)

(or: XEDIT  DRG  D)
```

Note: <u>CMB D</u> will contain the combustion process results.

<u>TRJ D</u> will contain the trajectory part.

<u>DRG D</u> will contain drag coefficients.

F2.4 <u>Hard Copy</u>

```
FILE

PRINT  CMB  D

PRINT  TRJ  D

PRINT  DRG  D
```

APPENDIX G:

G1. PROGRAM AERO(*): LISTING

(*) The original program was developed by T. H. Gawain [9]. The modification listed here was prepared for this report to calculate the cowl drag coefficient.

```
C
C     SPECIFICATION STATEMENTS
C
      IMPLICIT REAL*4(A-H,O-Z),INTEGER*4(I-N)
C
      DIMENSION X(702),R(702),RP(702),XH(702),FP(702),GP(702),
     +G(702),QA0(702),QA2(702),QNA(702),QMA(702),KAP(8)
C
      DATA KOE/'OE'/,KIN/'IN'/,KCG/'CG'/,KCO/'CO'/,KTO/'TO'/,
     +KPO/'PO'/,KQT/'QT'/,KON/'ON'/,KOT/'OT'/,XM/3.0000/,XL/17.50/,
     + NL/500/,NA/203/,NB/200/,NTAB/20/,KNOSE/'ON'/,KTAIL/'CT'/,
     +KAP/'X CC','ORDI','NATE',' ','(TO=','NEGA','TIVE',')    '/
     +,DL/-0.07360/,DL2/-0.1770/,NC/ 6/,NB2/61/,INOSE/  0/
C
C     SELECT OPTIONS
C
 1001 WRITE(6,1021)
 1021 FORMAT('1','ENTER CONTROL CODE AS FOLLOWS:'/
     +T6,'TO OBTAIN EXPLANATION',T41,'ENTER OE'/
     +T6,'TO ENTER INPUT PARAMETERS',T41,'ENTER IN'/
     +T6,'TO COMPUTE GEOMETRICAL ARRAYS',T41,'ENTER CG'/
     +T6,'TO CALCULATE OUTPUT',T41,'ENTER CO'/
     +T6,'TO TABULATE OUTPUT',T41,'ENTER TO'/
     +T6,'TO PLOT OUTPUT',T41,'ENTER PO'/
     +T6,'TO QUIT PROGRAM',T41,'ENTER QT'/)
      READ(5,1041,ERR=1061) KAR
 1041 FORMAT(A2)
      IF(KAR.EQ.KOE) GO TO 2001
      IF(KAR.EQ.KIN) GO TO 2081
      IF(KAR.EQ.KCG) GO TO 2741
      IF(KAR.EQ.KCO) GO TO 3281
      IF(KAR.EQ.KTO) GO TO 3381
      IF(KAR.EQ.KPO) GO TO 3601
      IF(KAR.EQ.KQT) GO TO 3721
 1061 WRITE(6,1081)
 1081 FORMAT(' ','INPUT ERROR. REPEAT INPUT')
      GO TO 1001
C
C     EXPLANATION
C
 2001 WRITE (6,2021)
 2021 FORMAT(' ','SUPERSONIC FLOW ABOUT A SLIGHTLY PITCHED, SLENDER,'/
     +' ','POINTED BODY OF REVOLUTION. THIS PROGRAM UTILIZES A'/
     +' ','MODIFIED LINEARIZED ANALYSIS DEVELOPED BY T.H.GAWAIN,'/
     +' ','AND MODIFIED FOR COWL DRAG CALCULATION OF A GUIDED'/
     +' ','PROJECTILE BY O.AMICHAI.'/
     +' ','CLASSICAL LINEARIZED THEORY SATISFIES THE BOUNDARY'/
     +' ','CONDITIONS ONLY APPROXIMATELY, AT THE AXIS; THE PRESENT'/
     +' ','METHOD SATISFIES THEM VERY ACCURATELY AT THE BODY SURFACE'/
     +' ','ITSELF.'/
     +' ','   THE BODY IS SCALED SO THAT THE LARGEST CROSS-SECTION IS'/
     +' ','A CIRCLE OF UNIT RADIUS. AERODYNAMIC COEFFICIENTS ARE BASED'/
     +' ','ON FRONTAL AREA.'/
     +' ','   THE CONFIGURATION CONSISTS OF A CONICAL OR OGIVAL NOSE, '/
     +' ','DENOTED BY SYMBOLS CN OR ON, RESPECTIVELY, AN'/
     +' ','OPTIONAL MID-SECTION OF UNIFORM UNIT RADIUS, AND AN OPTION-'/
     +' ','AL TAIL IN THE FORM OF A TRUNCATED CONE OR OGIVE, SYMBOL CT'/
     +' ','OR OT, RESPECTIVELY. TOTAL LENGTH XL IS SUBDIVIDED INTO NL'/
     +' ','INTERVALS OF UNIFORM WIDTH H=XL/NL. NOSE LENGTH AND MID-'/
     +' ','SECTION LENGTH ARE EXPRESSED AS NA*H AND NB*H, RESPECT-'/
     +' ','IVELY, WHERE NA AND NB ARE INTEGERS. PARAMETER DL DENOTES')
      WRITE(6,2041)
 2041 FORMAT(' ','THE DECREASE IN RADIUS OVER THE TAIL SECTION.'/
     +' ','      CALCULATIONS ARE MADE FOR EVERY STATION J BUT OUTPUT'/
     +' ','IS TABULATED ONLY FOR J=2+K*NTAB WHERE K=0,1,2,3,...'/
     +' ','      MACH NUMBER XM MUST LIE WITHIN THE RANGE 1.<XM<'/
     +' ','SQRT(1.+RPMAX**-2) WHERE RPMAX DENOTES THE MAXIMUM BODY'/
     +' ','SLOPE.'/
     +' ','      INPUT PARAMETERS ARE XM, XL, DL,NL, NA, NB, NTAB,CN OR'/
     +' ','ON, CT OR OT, AND AN OPTIONAL ALPHANUMERIC IDENTI-'/
     +' ','FIER UP TO 8 CHARACTERS IN LENGTH.'/
     +' ','      A CONTROL POINT IS LOCATED AT X=0., AT THE MIDPOINT OF'/
```

```
     +' ','EACH OF THE NL UNIFORM INTERVALS, AND AT X=XL. INDEX J=1,'/
     +' ','2,3,...(NL+2) DESIGNATES THESE POINTS. AT POINT J THE AXIAL'/
     +' ','COORDINATE, THE RADIAL COORDINATE AND THE BODY SLOPE ARE'/
     +' ','EXPRESSED AS X(J), R(J) AND RP(J), RESPECTIVELY. THESE'/
     +' ','ARRAYS ARE CALCULATED AFTER THE INPUT PARAMETERS HAVE'/
     +' ','BEEN ENTERED.'/
     +' ','    THE NORMAL AND AXIAL FORCE COEFFICIENTS ARE OF THE'/
     +' ','FOLLOWING FORM, WHERE S AND C DENOTE SINE AND COSINE OF A,'/
     +' ','THE ANGLE OF ATTACK. THUS  CN=CNA*C*S AND CA=CAO+CA2*S**2.')
      WRITE(6,2061)
 2061 FORMAT(' ','    THIS PROGRAM COMPUTES THE NUMERICAL VALUES OF'/
     +' ','COEFFICIENTS CNA, CAO AND CA2 AS WELL AS THE COORDINATE XAC'/
     +' ','OF THE AERODYNAMIC CENTER. PARAMETERS CNA, CAO AND CA2 ARE'/
     +' ','FOUND BY INTEGRATING CORRESPONDING DISTRIBUTIONS QNA, QAO'/
     +' ','AND QA2 WITH RESPECT TO X OVER THE LENGTH OF THE BODY.'/
     +' ','THESE DISTRIBUTIONS CAN BE OBTAINED IN TABULAR AND GRAPH-'/
     +' ','ICAL FORM. THE PROGRAM CAN BE CONTROLLED BY FOLLOWING THE'/
     +' ','PROMPTING INSTRUCTIONS WHICH APPEAR AT THE TERMINAL. THE'/
     +' ','PROGRAM STEPS "ENTER INPUT PARAMETERS","COMPUTE GEOMETRIC'/
     +' ','ARRAYS","CALCULATE OUTPUT" AND "PLOT OUTPUT" MUST BE PER-'/
     +' ','FORMED IN THE ORDER LISTED SINCE EACH STEP GENERATES DATA'/
     +' ','NEEDED FOR THE NEXT STEP.')
      WRITE(6,2065)
 2065 FORMAT(' ','    CHANGES:ADDING SECOND CONICAL TAIL.'/
     +' ','NB2,NC2 ARE INTEGERS.SIMILIAR TO THE ABOVE:DL2 DENOTES THE'/
     +' ','SECOND DECREASE IN RADIUS OVER THE TAIL SECTION;IN ORDER '/
     +' ','TO RECEIVE INCREASE IN RADIUS,DL,DL2 SHOULD BE NEGETIVE.'/
     +' ','SECOND TAIL WAS NOT ARANGED FOR OGIVAL TAIL PROFILE.'/
     +' ','THE NOSE PART (NA)  CAN BE INCLUDED IN CAO CALCULATION'/
     +' ','(INOSE=1) OR IT CAN BE USED ONLY TO ARRANGE THE FLOW'/
     +' ','CONDITIONS(INOSE=0)')
      GO TO 1001
C
C     ENTER INPUT PARAMETERS
C
 2081 WRITE(6,2101) XM,XL,DL,NL,NA,NB,NTAB,KNOSE,KTAIL,KAP(6),KAP(7)
     +,NC,NB2,DL2,INOSE
 2101 FORMAT(' ','PRESENT INPUT PARAMETERS ARE:'/
     +' ','ITEM 1      XM=',F7.4/
     +' ','ITEM 2      XL=',F7.3/
     +' ','ITEM 3      DL=',F6.4/
     +' ','ITEM 4      NL=',I3/
     +' ','ITEM 5      NA=',I3/
     +' ','ITEM 6      NB=',I3/
     +' ','ITEM 7      NTAB=',I3/
     +' ','ITEM 8      NOSE CODE=',A2/
     +' ','ITEM 9      TAIL CODE=',A2/
     +' ','ITEM 10     IDENTIFICATION NUMBER=',2A4/
     +' ','ITEM 11     NC=',I3/
     +' ','ITEM 12     NB2=',I3/
     +' ','ITEM 13     DL2=',F6.4/
     +' ','ITEM 14     INOSE=',I3//
     +' ','TO CHANGE ANY ITEM ENTER ITEM NUMBER IN I3 FORMAT.'/
     +' ','TO EXIT ENTER -01')
 2121 READ(5,2141,ERR=2161) KAR
 2141 FORMAT(I3)
      IF(KAR.EQ.001) GO TO 2201
      IF(KAR.EQ.002) GO TO 2261
      IF(KAR.EQ.003) GO TO 2321
      IF(KAR.EQ.004) GO TO 2381
      IF(KAR.EQ.005) GO TO 2441
      IF(KAR.EQ.006) GO TO 2481
      IF(KAR.EQ.007) GO TO 2521
      IF(KAR.EQ.008) GO TO 2561
      IF(KAR.EQ.009) GO TO 2621
      IF(KAR.EQ.010) GO TO 2681
      IF(KAR.EQ.011) GO TO 2683
      IF(KAR.EQ.012) GO TO 2685
      IF(KAR.EQ.013) GO TO 2687
      IF(KAR.EQ.014) GO TO 2689
      IF(KAR.EQ.-01) GO TO 1001
C
```

```
C       INPUT ERROR MESSAGE
C
 2161  WRITE(6,2181)
 2181  FORMAT(' ','INPUT ERROR. REENTER ITEM NUMBER.')
       GO TO 2121
C
C       ENTER MACH NUMBER XM
C
 2201  WRITE(6,2221)
 2221  FORMAT(' ','ENTER XM IN DECIMAL FORMAT.')
       READ(5,2241,ERR=2161) XM
 2241  FORMAT(F7.4)
       GO TO 2081
C
C       ENTER LENGTH XL
C
 2261  WRITE(6,2281)
 2281  FORMAT(' ','ENTER XL IN DECIMAL FORMAT.')
       READ(5,2301,ERR=2161) XL
 2301  FORMAT(F6.3)
       GO TO 2081
C
C       ENTER TAIL TAPER DL
C
 2321  WRITE(6,2341)
 2341  FORMAT(' ','ENTER DL, IF APPLICABLE, IN DECIMAL FORMAT.')
       READ(5,2361,ERR=2161) DL
 2361  FORMAT(F6.4)
       GO TO 2081
C
C       ENTER BODY LENGTH INTEGER NL
C
 2381  WRITE(6,2401)
 2401  FORMAT(' ','ENTER NL IN I3 FORMAT.')
       READ(5,2421,ERR=2161) NL
 2421  FORMAT(I3)
       GO TO 2081
C
C       ENTER NOSE LENGTH INTEGER NA
C
 2441  WRITE(6,2461)
 2461  FORMAT(' ','ENTER NA IN I3 FORMAT.')
       READ(5,2421,ERR=2161) NA
       GO TO 2081
C
C       ENTER MIDSECTION LENGTH INTEGER NB
C
 2481  WRITE(6,2501)
 2501  FORMAT(' ','ENTER NB IN I3 FORMAT.')
       READ(5,2421,ERR=2161) NB
       GO TO 2081
C
C       ENTER TABULAR INTERVAL NTAB
C
 2521  WRITE(6,2541)
 2541  FORMAT(' ','ENTER NTAB IN I3 FORMAT.')
       READ(5,2421,ERR=2161) NTAB
       GO TO 2081
C
C       ENTER CODE FOR CONICAL OR OGIVAL NOSE
C
 2561  WRITE(6,2581)
 2581  FORMAT(' ','ENTER NOSE CODE "CN" OR "ON".')
       READ(5,2601,ERR=2161) KNOSE
 2601  FORMAT(A2)
       GO TO 2081
C
C       ENTER CODE FOR CONICAL OR OGIVAL TAIL
C
 2621  WRITE(6,2641)
 2641  FORMAT(' ','ENTER TAIL CODE "CT" OR "OT" IF APPLICABLE.')
       READ(5,2661,ERR=2161) KTAIL
```

```
 2661 FORMAT(A2)
      GO TO 2081
C
C     ENTER IDENTIFICATION NUMBER
C
 2681 WRITE(6,2701)
 2701 FORMAT(' ','ENTER OPTIONAL ID NUMBER IN A8 FORMAT.')
      READ(5,2721,ERR=2161) KAP(6),KAP(7)
 2721 FORMAT(2A4)
      GO TO 2081
C
C     ENTER FIRST TAIL LENGTH INTEGER NC
C
 2683 WRITE(6,2703)
 2703 FORMAT(' ','ENTER NC IN I3 FORMAT.')
      READ(5,2421,ERR=2161)NC
      GO TO 2081
C
C     ENTER SECOND MIDSECTION LENGTH INTEGER NB2
C
 2685 WRITE(6,2705)
 2705 FORMAT(' ','ENTER NB2 IN I3 FORMAT.')
      READ(5,2421,ERR=2161)NB2
      GO TO 2081
C
C     ENTER TAIL SECOND TAPER DL2
C
 2687 WRITE(6,2707)
 2707 FORMAT(' ','ENTER DL2,IF APPLICABLE, IN DECIMAL FORMAT.')
      READ(5,2361,ERR=2161)DL2
      GO TO 2081
C
C     ENTER INOSE OPTION
C
 2689 WRITE(6,2709)
 2709 FORMAT(' ','ENTER INOSE IN I3 FORMAT',/' '
     +         ,'IF INCLUDED IN CAO,WRITE 1',/' '
     +         ,'IF ONLY TO ARRANGE FLOW,WRITE 0')
      READ(5,2421,ERR=2161)INOSE
      GO TO 2081
C
C     CALCULATE GEOMETRICAL ARRAYS
C
C     SET UP INPUT AND CALCULATE X(J)
C
 2741 IF(NB2.EQ.0)NC=NL-NA-NB
      NC2=NL-NA-NB-NC-NB2
      DELX=XL/FLOAT(NL)
      AL=DELX*FLOAT(NA)
      BL=DELX*FLOAT(NB)
      CL=DELX*FLOAT(NC)
      CL2=DELX*FLOAT(NC2)
      JAL=NA+1
      JAR=JAL+1
      JBL=NA+NB+1
      JBR=JBL+1
      JCL=NA+NB+NC+1
      JCR=JCL+1
      JB2L=NA+NB+NC+NB2+1
      JB2R=JB2L+1
      X(1)=0.
      R(1)=0.
      NLP1=NL+1
      NLP2=NL+2
      X(NLP2)=XL
      DO 2761 J=2,NLP1
         DELJ=FLOAT(J)-1.5
         X(J)=DELX*DELJ
 2761 CONTINUE
 2781 IF(KNOSE.EQ.KON) GO TO 3001
C
C     CALCLATE R(J) AND RP(J) FOR CONICAL NOSE
```

```
C
 2801 RPA=1./AL
      RP(1)=RPA
      DO 2821  J=2,JAL
         R(J)=X(J)/AL
         RP(J)=RPA
 2821 CONTINUE
 2841 IF(NA.LT.NL) GO TO 3081
 2861 R(NLP2)=1.
      RP(NLP2)=RPA
      GO TO 3241
C
C     CALCULATE R(J) AND RP(J) FOR OGIVAL NOSE
C
 3001 RA=(1.+AL**2)/2.
      DO 3021  J=1,JAL
      IF((RA*RA-(AL-X(J))**2).GE.0.0)GO TO 3026
      WRITE(2,3024)J,RA,AL,X(J),R(J),RP(J)
 3024 FORMAT(' ','3024',2X,I3,2X,5(F10.3,2X))
      GO TO 3777
 3026    R(J)=SQRT(RA*RA-(AL-X(J))**2)-RA+1.
         RP(J)=(AL-X(J))/(RA-1.+R(J))
 3021 CONTINUE
 3041 IF(NA.LT.NL) GO TO 3081
 3061 R(NLP2)=1.
      RP(NLP2)=.0
      GO TO 3241
C
C     CALCULATE R(J) AND RP(J) FOR CYLINDRICAL MIDSECTION
C
 3081 IF(NB.EQ.0) GO TO 3121
      DO 3101  J=JAR,JBL
         R(J)=1.
         RP(J)=.0
 3101 CONTINUE
      IF((NA+NB).LT.NL)GO TO 3121
      R(NLP2)=1.
      RP(NLP2)=.0
      GO TO 3241
 3121 IF(KTAIL.EQ.KOT) GO TO 3161
C
C     CALCULATE R(J) AND RP(J) FOR CONICAL TAIL
C
      RPT=-DL/CL
      RXL=AL+BL+CL
      DO 3141  J=JBR,JCL
         R(J)=1.+RPT*(X(J)-RXL+CL)
         RP(J)=RPT
 3141 CONTINUE
      IF((NA+NB+NC).LT.NL)GO TO 3123
      R(NLP2)=1.-DL
      RP(NLP2)=RPT
      GO TO 3241
C
C     CALCULATE R(J) AND RP(J) FOR SECOND MIDSECTION
C
 3123 IF(NB2.EQ.0) GO TO 3241
      DO 3125  J=JCR,JB2L
         R(J)=1.-DL
         RP(J)=.0
 3125 CONTINUE
      IF((NA+NB+NC+NB2).LT.NL)GO TO 3127
      R(NLP2)=1.-DL
      RP(NLP2)=.0
      GO TO 3241
C
C     CALCULATE R(J) AND RP(J) FOR SECOND CONICAL TAIL
C
 3127 RPT2=-DL2/CL2
      DO 3129  J=JB2R,NLP2
         R(J)=1-DL+RPT2*(X(J)-XL+CL2)
         RP(J)=RPT2
```

```
 3129 CONTINUE
      GO TO 3241
C
C     CALCULATE R(J) AND RP(J) FOR OGIVAL TAIL
C
 3161 IF(DL.GT.0..AND.DL.LE.1.) GO TO 3201
      WRITE(6,3181)
 3181 FORMAT(' ','REVISE INPUT. DL.GT.0..AND.DL.LE.1.')
      GO TO 1001
 3201 RC=(CL*CL+DL*DL)/(2.*DL)
      DO 3221  J=JBR,NLP2
         R(J)=1.-RC+SQRT(RC*RC-(X(J)-XL+CL )**2)
         RP(J)=-(X(J)-XL+CL)/(RC-1.+R(J))
 3221 CONTINUE
C
C     COMPLETION MESSAGE
C
 3241 WRITE(6,3261)
 3261 FORMAT(' ','GEOMETRICAL ARRAYS COMPLETED')
      GO TO 1001
C
C     CALCULATE OUTPUT
C
 3281 BETA=SQRT(XM*XM-1.)
      XI(1)=0.
      T=X(2)**2-(BETA*R(2))**2
      IF(T.GE.0.0)GO TO 3286
      WRITE(2,3284)X(2),R(2),BETA,T
 3284 FORMAT(' ','3284',4(E10.3,2X))
      GO TO 3777
 3286 T=SQRT(T)
      G(1)=0.
      QA0(1)=0.
      QA2(1)=0.
      QNA(1)=0.
      QMA(1)=0.
      CA0=0.
      CA2=0.
      CNA=0.
      CMA=0.
         CA01=0.
         CA03=0.
C
      DO 3341  J=2,NLP2
         SUMC=0.
         SUMF=0.
         SUMB=0.
         SX=0.
         TX=0.
         TR=0.
      IF(R(J).NE.0.0)GO TO 3345
      WRITE(2,3343)J,X(J),R(J),RP(J)
 3343 FORMAT(' ','3343',2X,I3,3(2X,E10.3))
      GO TO 3777
 3345    XI(J)=X(J)-BETA*R(J)
         H=X(J)-X(J-1)
         HA=XI(J)-XI(J-1)
         T=X(J)**2-(BETA*R(J))**2
      IF(T.GE.0.0)GO TO 3348
      WRITE(2,3346)X(J),R(J),RP(J),BETA,T,J
 3346 FORMAT(' ','3346',5(E10.3,2X),I3)
      GO TO 3777
 3348    T=SQRT(T)
C
         IF(J.EQ.2) GO TO 3321
C
         J1=J-1
         DO 3301 I=2,J1
               TP=T
               T=(X(J)-XI(I))**2-(BETA*R(J))**2
      IF(T.LT.0.0)GO TO 3302
               T=SQRT(T)
```

```
      IF((X(J)-XI(I)+T).NE.0.0)GO TO 3307
 3302 WRITE(2,3305)J,I,X(J),XI(I),X(I-1),R(I),R(J),RP(J),BETA,T,TP
 3305 FORMAT(' ','3305',2X,2(I3,2X),9(E10.3,2X))
      GO TO 3777
 3307          A=(X(J)-XI(I-1)+TP)/(X(J)-XI(I)+T)
      IF(A.LE.0.0)GO TO 3302
               A=ALOG(A)
               B=(TP-T)/R(J)
               C=B+RP(J)*A
               D=((X(J)-XI(I-1))*TP-(X(J)-XI(I))*T)/(2.*R(J)**2)
               E=(X(J)-XI(I-1))*B/R(J)-D-BETA*BETA*A/2.
               F=F+BETA*BETA*A+RP(J)*B
               SUMC=SUMC+C*FP(I)
               SUMF=SUMF+F*GP(I)
               SUMB=SUMB+B*G(I-1)
               SX=SX+A*FP(I)
               TX=TX+B*GP(I)
               TR=TR+BETA*BETA*A*GP(I)
 3301    CONTINUE
 3321    CONTINUE
         TP=T
         T=0.
      IF((X(J)-XI(J)).NE.0.0)GO TO 3325
      A=1.
      GO TO 3327
 3325    A=(X(J)-XI(J-1)+TP)/(X(J)-XI(J))
      IF(A.GT.0.0)GO TO 3329
 3327 B=1.
      C=1.
      D=1.
      E=1.
      F=1.
      GO TO 3331
 3329    A=ALOG(A)
         B=TP/R(J)
         C=B+RP(J)*A
         D=(X(J)-XI(J-1))*TP/(2.*R(J)**2)
         E=(X(J)-XI(J-1))*B/R(J)-D-BETA*BETA*A/2.
         F=F+BETA*BETA*A+RP(J)*B
      IF(C.NE.0.0)GO TO 3333
      GO TO 3331
 3333 IF(F.NE.0.0)GO TO 3337
 3331 WRITE(2,3335)J,X(J),XI(J-1),XI(J),TP,R(J),RP(J),BETA,A,B,C,D,E,F
 3335 FORMAT(' ','3335',2X,I3,2X,6(E10.3,2X)/' ',7(E10.3,2X))
      GO TO 3777
 3337    SUMB=SUMB+B*G(J-1)
         FP(J)=(RP(J)-SUMC)/C
         GP(J)=(1.-SUMF-SUMB/R(J))/F
         G(J)=G(J-1)+HA*GP(J)
         SX=SX+A*FP(J)
         TX=TX+B*GP(J)
         TR=TR+BETA*BETA*A*GP(J)
         SR=RP(J)*(1.-SX)
         TF=1.-TR-RP(J)*TX
         GA0=1.-(1.+RP(J)**2)*(1.-SX)**2+(XM*SX)**2
         GA2=-(XM*SX)**2+(1.+RP(J)**2)*(1.-SX)**2+
     +         (BETA*BETA-RP(J)**2)*(TX**2)/2.-((1.+TF)**2)/2.
         GNA=((1.+RP(J)**2)*(1.-SX)+XM*XM*SX)*TX
         QA0(J)=2.*R(J)*RP(J)*GA0
         QA2(J)=2.*R(J)*RP(J)*GA2
         QNA(J)=2.*R(J)*GNA
         QMA(J)=(R(J)*RP(J)+X(J))*QNA(J)
           IF(INOSE.GT.0)GO TO 3339
           IF(J.GT.JAL)GO TO 3339
           CA01=CA01+(QA0(J)+QA0(J-1))*H/2.
 3339      CONTINUE
         CA03=CA03+(QA0(J)+QA0(J-1))*H/2.
         CA2=CA2+(QA2(J)+QA2(J-1))*H/2.
         CNA=CNA+(QNA(J)+QNA(J-1))*H/2.
         CMA=CMA+(QMA(J)+QMA(J-1))*H/2.
 3341 CONTINUE
           CA0=CA03-CA01
```

```
      IF(CNA.NE.0.0)GO TO 3355
      WRITE(2,3353)CNA
 3353 FORMAT(' ','3353',E10.3)
      GO TO 3777
 3355 XAC=CMA/CNA
      WRITE(6,3361)
 3361 FORMAT(' ','CALCULATION COMPLETED')
      GO TO 1001
C
C     TABULATE OUTPUT
C
 3381 WRITE(2,3401)
 3401 FORMAT('1',16X,'FORCE COEFFICIENTS FOR A SLENDER, POINTED'/
     +18X, 'BODY OF REVOLUTION IN SUPERSONIC FLOW')
      WRITE(2,3421) XM,XL,DL,DL2,NL,NA,NB,NC,NB2,NC2,NTAB,INOSE,
     +KNOSE,KTAIL,KAP(6),KAP(7),CNA,CA0,CA2,XAC
 3421 FORMAT('0','XM=',F7.4,T18,'XL=',F7.4,T36,'DL=',F6.4,T54,
     +'DL2=',F6.4/
     +' ','NL=',I3,T18,'NA=',I3,T36,'NB=',I3,T54,'NC=',I3/
     +' ','NB2=',I3,T18,'NC2=',I3,T36,'NTAB=',I3,T54,'INOSE=',I2/
     +' ','NOSE CODE=',A2,T27,'TAIL CODE=',A2,T54,
     +    'ID=',2A4/' ','CNA=',F6.4,T18,'CA0=',F6.4,T36,'CA2=',F7.4,
     +    T54,'XAC=',F8.3)
      WRITE(2,3441)
 3441 FORMAT('0',2X,'J',15X,'X',15X,'R',14X,'RP')
      DO 3461 J=2,NLP2,NTAB
         WRITE(2,3561) J,X(J),R(J),RP(J)
 3461 CONTINUE
      WRITE(2,3541)
 3541 FORMAT('0',2X,'J',15X,'X',13X,'QNA',13X,'QA0',13X,'QA2')
      DO 3581 J=2,NLP2,NTAB
         WRITE(2,3561) J,X(J),QNA(J),QA0(J),QA2(J)
 3561    FORMAT(' ',I3,4E16.4)
 3581 CONTINUE
      GO TO 1001
C
C     PLOT OUTPUT
C
C     WRITE OUTPUT FOR PLOT INTO  FILE FT01F001
C
 3601 WRITE(1,3621) XM,XL,DL,NL,NA,NB,NTAB,KNOSE,KTAIL,
     +KAP,CNA,CA0,CA2,XAC
 3621 FORMAT(' ',3E14.5,4(2X,I3),2(2X,A2)/' ',8A4/' ',4E14.5)
      DO 3661 J=1,NLP2
         WRITE(1,3641) X(J),R(J),QNA(J),QA0(J),QA2(J)
 3641    FORMAT(' ',5E14.5)
 3661 CONTINUE
C
      WRITE(1,3681)
 3681 FORMAT(' ','/*')
      WRITE(6,3701)
 3701 FORMAT(' ','TO OBTAIN  PLOTS,FIRST ENTER QT TO QUIT PROGRAM,'/
     +' ','THEN ISSUE THE FOLLOWING COMMAND:'/
     +' ',8X,'FOR PRINTER PLOTS',T36,'ENTER "CHARTS PRINTER"'/
     +' ',8X,'FOR PLOTTER GRAPHS',T36,'ENTER "CHARTS PLOTTER"')
      GO TO 1001
C
C     QUIT PROGRAM
C
 3721 CONTINUE
      WRITE(6,3741)
 3741 FORMAT(' ','EXECUTION TERMINATED')
 3777 STOP
      END
```

G2. PROGRAM COWL

ADJUSTMENT OF AERO FOR DO-LOOP ROUTINE

```
      XM=1.95
      GA=1.4
      DO 33 J=1,22
      XM=XM+0.05
      IF(J.EQ.1)XM=1.45
      CALL DRAGN(XM,CAO)
C     CALL DRAGWW(XM,GA,CDWW)
      IF(J.EQ.1)XM=1.95
   33 CONTINUE
      STOP
      END

      SUBROUTINE DRAGN(XM,CAO)
      IMPLICIT REAL*4(A-H,O-Z),INTEGER*4(I-N)
C
      DIMENSION X(702),R(702),RP(702),XI(702),FP(702),QAO(702),KAP(8)
C
C     CALCULATE GEOMETRICAL ARRAYS
C
C        DATA FOR DL2:
C        -0.12077=6.5DEG.;-0.1770=9.5 DEG.;-0.2250=12 DEG.;-0.2840=
C        =15 DEG
C
      DATA XL/17.50/,NL/500/,NA/203/,NB/200/,NC/  6/,NB2/ 61/
     +,DL/-0.07360/,DL2/-0.17700/
C    #,XL/16.76/,NA/212/,NB/209/,NC/ 79/,NB2/0/,DL/-0.2780/
C     SET UP INPUT AND CALCULATE X(J)
C
 2741 IF(NB2.EQ.0)NC=NL-NA-NB
      NC2=NL-NA-NB-NC-NB2
      DELX=XL/FLOAT(NL)
      AL=DELX*FLOAT(NA)
      BL=DELX*FLOAT(NB)
      CL=DELX*FLOAT(NC)
      CL2=DELX*FLOAT(NC2)
      JAL=NA+1
      JAP=JAL+1
      JBL=NA+NB+1
      JBP=JBL+1
      JCL=NA+NB+NC+1
      JCP=JCL+1
      JB2L=NA+NB+NC+NB2+1
      JB2P=JB2L+1
      X(1)=0.
      R(1)=0.
      NLP1=NL+1
      NLP2=NL+2
      X(NLP2)=XL
      DO 2761  J=2,NLP1
         DELJ=FLOAT(J)-1.5
         X(J)=DELX*DELJ
 2761 CONTINUE
C
C     CALCULATE R(J) AND RP(J) FOR OGIVAL NOSE
C
 3001 RA=(1.+AL**2)/2.
      DO 3021  J=1,JAL
      IF((RA*RA-(AL-X(J))**2).GE.0.0)GO TO 3026
      WRITE(2,3024)J,RA,AL,X(J),R(J),RP(J)
 3024 FORMAT(' ','3024',2X,I3,2X,5(F10.3,2X))
      STOP
 3026    R(J)=SQRT(RA*RA-(AL-X(J))**2)-RA+1.
         RP(J)=(AL-X(J))/(RA-1.+R(J))
 3021 CONTINUE
 3041 IF(NA.LT.NL) GO TO 3081
 3061 R(NLP2)=1.
      RP(NLP2)=.0
      GO TO 3241
C
C     CALCULATE R(J) AND RP(J) FOR CYLINDRICAL MIDSECTION
C
 3081 IF(NB.EQ.0) GO TO 3121
```

```
      RP(J)=.0
 3101 CONTINUE
      IF((NA+NB).LT.NL)GO TO 3121
      R(NLP2)=1.
      RP(NLP2)=.0
      GO TO 3241
 3121 CONTINUE
C
C     CALCULATE R(J) AND RP(J) FOR CONICAL TAIL
C
      RPT=-DL/CL
      RXL=AL+BL+CL
      DO 3141 J=JBR,JCL
         R(J)=1.+RPT*(X(J)-RXL+CL)
         RP(J)=RPT
 3141 CONTINUE
      IF((NA+NB+NC).LT.NL)GO TO 3123
      R(NLP2)=1.-DL
      RP(NLP2)=RPT
      GO TO 3241
C
C     CALCULATE R(J) AND RP(J) FOR SECOND MIDSECTION
C
 3123 IF(NB2.EQ.0) GO TO 3241
      DO 3125 J=JCR,JB2L
         R(J)=1.-DL
         RP(J)=.0
 3125 CONTINUE
      IF((NA+NB+NC+NB2).LT.NL)GO TO 3127
      R(NLP2)=1.-DL
      RP(NLP2)=.0
      GO TO 3241
C
C     CALCULATE R(J) AND RP(J) FOR SECOND CONICAL TAIL
C
 3127 RPT2=-DL2/CL2
      DO 3129 J=JB2R,NLP2
         R(J)=1-DL+RPT2*(X(J)-XL+CL2)
         RP(J)=RPT2
 3129 CONTINUE
C
 3241 CONTINUE
C     CALCULATE OUTPUT
C
 3281 BETA=SQRT(XM*XM-1.)
      XI(1)=0.
      T=X(2)**2-(BETA*R(2))**2
      IF(T.GE.0.0)GO TO 3286
      WRITE(2,3284)X(2),R(2),BETA,T
 3284 FORMAT(' ','3284',4(E10.3,2X))
      STOP
 3286 T=SQRT(T)
      QAC(1)=0.
         CA01=0.
         CA03=0.
      CA0=0.
C
      DO 3341 J=2,NLP2
         SUMC=0.
         SUMF=0.
         SUMB=0.
         SX=0.
         TX=0.
         TP=0.
      IF(R(J).NE.0.0)GO TO 3345
      WRITE(2,3343)J,X(J),R(J),RP(J)
 3343 FORMAT(' ','3343',2X,I3,3(2X,E10.3))
      STOP
 3345    XI(J)=X(J)-BETA*R(J)
         H=X(J)-X(J-1)
         HA=XI(J)-XI(J-1)
         T=X(J)**2-(BETA*R(J))**2
```

```
      IF(T.GE.0.0)GO TO 3348
      WRITE(2,3346)X(J),R(J),RP(J),BETA,T,J
 3346 FORMAT(' ','3346',5(E10.3,2X),I3)
      STOP
 3348    T=SQRT(T)
C
         IF(J.EQ.2) GO TO 3321
C
         J1=J-1
         DO 3301 I=2,J1
               TP=T
               T=(X(J)-XI(I))**2-(BETA*R(J))**2
      IF(T.LT.0.0)GO TO 3302
               T=SQRT(T)
      IF((X(J)-XI(I)+T).NE.0.0)GO TO 3307
 3302 WRITE(2,3305)J,I,X(J),XI(I),X(I-1),R(I),R(J),RP(J),BETA,T,TP
 3305 FORMAT(' ','3305',2X,2(I3,2X),9(E10.3,2X))
      STOP
 3307          A=(X(J)-XI(I-1)+TP)/(X(J)-XI(I)+T)
      IF(A.LE.0.0)GO TO 3302
               A=ALOG(A)
               B=(TP-T)/R(J)
               C=B+RP(J)*A
               SUMC=SUMC+C*FP(I)
               SX=SX+A*FP(I)
 3301    CONTINUE
 3321    CONTINUE
         TP=T
         T=0.
      IF((X(J)-XI(J)).NE.0.0)GO TO 3325
      A=1.
      GO TO 3327
 3325    A=(X(J)-XI(J-1)+TP)/(X(J)-XI(J))
      IF(A.GT.0.0)GO TO 3329
 3327 B=1.
      C=1.
      GO TO 3331
 3329    A=ALOG(A)
         B=TP/R(J)
         C=B+RP(J)*A
      IF(C.NE.0.0)GO TO 3337
 3331 WRITE(2,3335)J,X(J),XI(J-1),XI(J),TP,R(J),RP(J),BETA,A,B,C
 3335 FORMAT(' ','3335',2X,I3,2X,6(E10.3,2X)/' ',4(E10.3,2X))
      STOP
 3337    FP(J)=(RP(J)-SUMC)/C
         SX=SX+A*FP(J)
         GAO=1.-(1.+RP(J)**2)*(1.-SX)**2+(XM*SX)**2
         QAO(J)=2.*R(J)*RP(J)*GAO
               IF(J.GT.JAL)GO TO 3339
               CA01=CA01+(QAO(J)+QAO(J-1))*H/2.
 3339          CONTINUE
         CA03=CA03+(QAO(J)+QAO(J-1))*H/2.
 3341 CONTINUE
               CAO=CA03-CA01
      WRITE(2,3344)XM,XL,NL,NA,NB,NC,NB2,DL2,CAO
 3344 FORMAT(' ',F5.2,2X,F7.4,5(2X,I3),2(2X,F7.4))
      RETURN
      END

      SUBROUTINE DRAGWW(XM,GA,CDWW)
      PI=4.*ATAN(1.)
      RADEG=PI/180.
      DATA TWO/5./,DREF/5./,B/0.09525/,C/0.0635/,T/0.01/
      AREF=PI*(DREF*0.0254)**2/4.
CC       ALL LENGTHS IN METERS.
      TW=TWO*RADEG
      XM1=XM
      XM2=XM
      CALL PRANT(XM,GA,ANIO)
      ANI1=ANIO-TW
      ANI2=ANIO+TW
      CALL PRES(XM,GA,POPT)
```

FILE: COWL   FORTRAN A   NAVAL POSTGRADUATE SCHOOL

```
      CALL APRANT(XM1,GA,ANI1)
      CALL PRES(XM1,GA,P1PT)
      CALL APRANT(XM2,GA,ANI2)
      CALL PRES(XM2,GA,P2PT)
C
      BP=B-C/2/SQRT(XM**2-1)
      COWW=(2./(GA*XM**2))*(P1PT/POPT-P2PT/POPT)*(T*BP/AREF)
      WRITE(2,334)XM,XM1,XM2,POPT,P1PT,P2PT,TW,B,BP,C,COWW
  334 FORMAT(' ','334',6(2X,F8.5)/' ','   ',5(2X,F8.5)/
     +' ',75('*'))
      RETURN
      END

      SUBROUTINE PRANT(XMI,GA,ANI)
      BETA=SQRT(XMI**2-1.)
      GARAT=SQRT((GA-1.)/(GA+1.))
      ANI=ATAN(GARAT*BETA)/GARAT-ATAN(BETA)
      RETURN
      END

      SUBROUTINE APRANT(XMI,GA,ANI)
      BETA=SQRT(XMI**2-1.)
      GARAT=SQRT((GA-1.)/(GA+1.))
      IBETA=0
  552 F=ATAN(GARAT*BETA)/GARAT-ATAN(BETA)-ANI
      FP=1./(1.+(GARAT*BETA)**2)-1./(1.+BETA**2)
      IBETA=IBETA+1
      IF(IBETA.GT.12)GO TO 558
      IF(FP.EQ.0.0)GO TO 558
      BETAN=BETA-F/FP
      IF((ABS(BETAN-BETA)).LE.(1.E-05))GO TO 556
      BETA=BETAN
      GO TO 552
  556 XMI=SQRT(BETA**2+1.)
      RETURN
  558 WRITE(2,560)IBETA,ANI,F,FP,BETA
  560 FORMAT(' ','560',I3,4(2X,F11.4))
      STOP
      END

      SUBROUTINE PRES(XMI,GA,PIPT)
      PIPT=(1.+(GA-1.)/2.*XMI**2)**(-GA/(GA-1.))
      RETURN
      END
```

G3. PLOT ROUTINES FOR USE WITH AERO [9]

-PREPLOT P (PLOT ON PRINTER)

-PREPLOT G (PLOT ON PLOTTER)

-CHARTS (CONTROL)

FILE: PREPLOTP FORTRAN A NAVAL POSTGRADUATE SCHOOL

```
//AMIC3250 JOB (3250,0258),'AMICHAI X2936',CLASS=A
// EXEC  FRTXCLGP
//FORT.SYSIN  DD  *
C
C      SPECIFICATION STATEMENTS
C
       IMPLICIT REAL*4(A-H,O-X),INTEGER*4(I-N)
C
       DIMENSION X(502),R(502),QNA(502),QAO(502),QA2(502),KAP(8)
C
       READ(5,1000) XM,XL,DL,NL,NA,NB,NTAB,KNOSE,KTAIL,
      +KAP,CNA,CAO,CA2,XAC
 1000 FORMAT(1X,3E14.5,4(2X,I3),2(2X,A2)/1X,8A4/1X,4E14.5)
       NLP2=NL+2
       DO 1040 J=1,NLP2
          READ(5,1020) X(J),R(J),QNA(J),QAO(J),QA2(J)
 1020     FORMAT(1X,5E14.5)
 1040 CONTINUE
       WRITE(6,1060)
 1060 FORMAT('1','SUMMARY OF RESULTS'///)
       WRITE(6,1080) XM,XL,DL,NL,NA,NB,NTAB,KNOSE,KTAIL,KAP(6),KAP(7),
      +CNA,CAO,CA2,XAC
 1080 FORMAT('0','XM=',F7.4,T18,'XL=',F7.4,T36,'DL=',F6.4,T54,'NL=',I3/
      +'0','NA=',I3,T18,'NB=',I3,T36,'NTAB=',I3,T54,'NOSE CODE=',A2/
      +'0','TAIL CODE=',A2,T36,'ID=',2A4/'0','CNA=',F6.4,T18,'CAO=',
      +F6.4,T36,'CA2=',F7.4,T54,'XAC=',F8.3)
       WRITE(6,1100) XM,KAP(6),KAP(7)
 1100 FORMAT('1',36X,'RADIUS R VS X   XM=',F7.4,'     ID=',2A4///)
       CALL PLOTP(X,R,NLP2,4)
       WRITE(6,1120)
 1120 FORMAT('1',36X,'NORMAL FORCE COEFFICIENT QNA VS X'/)
       WRITE(6,1140) CNA,XAC,KAP(6),KAP(7)
 1140 FORMAT('0',36X,'CNA=',F7.4,'          XAC=',F9.4,'     ID=',2A4//)
       CALL PLOTP(X,QNA,NLP2,4)
       WRITE(6,1160)
 1160 FORMAT('1',36X,'AXIAL FORCE COEFFICIENT QAO VS X'/)
       WRITE(6,1180) CAO,KAP(6),KAP(7)
 1180 FORMAT('0',36X,'CAO=',F7.4,'     ID=',2A4//)
       CALL PLOTP(X,QAO,NLP2,4)
       WRITE(6,1200)
 1200 FORMAT('1',36X,'AXIAL FORCE COEFFICIENT QA2 VS X'/)
       WRITE(6,1220) CA2,KAP(6),KAP(7)
 1220 FORMAT('0',36X,'CA2=',F7.4,'     ID=',2A4//)
       CALL PLOTP(X,QA2,NLP2,4)
       STOP
       END
/*
//GO.SYSIN  DD  *
```

FILE: PREPLOTG FORTRAN A NAVAL POSTGRADUATE SCHOOL

```
//AMIC3250 JOB (3250,0258),'AMICHAI X2936',CLASS=A
// EXEC  FRTXCLGP
//FORT.SYSIN  DD  *
C
C      SPECIFICATION STATEMENTS
C
       IMPLICIT REAL*4(A-H,O-X),INTEGER*4(I-N)
C
       DIMENSION X(502),R(502),QNA(502),QAO(502),QA2(502),KAP(8)
C
       READ(5,1000) XM,XL,DL,NL,NA,NB,NTAB,KNOSE,KTAIL,
      +KAP,CNA,CAO,CA2,XAC
 1000  FORMAT(1X,3E14.5,4(2X,I3),2(2X,A2)/1X,8A4/1X,4E14.5)
       NLP2=NL+2
       DO 1040 J=1,NLP2
          READ(5,1020) X(J),R(J),QNA(J),QAO(J),QA2(J)
 1020     FORMAT(1X,5E14.5)
 1040  CONTINUE
       WRITE(6,1060)
 1060  FORMAT('1','SUMMARY OF RESULTS'///)
       WRITE(6,1080) XM,XL,DL,NL,NA,NB,NTAB,KNOSE,KTAIL,KAP(6),KAP(7),
      +CNA,CAO,CA2,XAC
 1080  FORMAT('C','XM=',F7.4,T18,'XL=',F7.4,T36,'DL=',F6.4,T54,'NL=',I3/
      +'0','NA=',I3,T18,'NB=',I3,T36,'NTAB=',I3,T54,'NOSE CODE=',A2/
      +'0','TAIL CODE=',A2,T36,'ID=',2A4/'0','CNA=',F6.4,T18,'CAO=',
      +F6.4,T36,'CA2=',F7.4,T54,'XAC=',F8.3)
       CALL PLOTG(X,R,NLP2,1,1,0,KAP,32,'RADIUS R',8,0.,0.,0.,0.,8.5,6.)
       CALL PLOTG(X,QNA,NLP2,1,1,0,KAP,32,'QNA',3,0.,0.,0.,0.,8.5,6.)
       CALL PLOTG(X,QAO,NLP2,1,1,0,KAP,32,'QAO',3,0.,0.,0.,0.,8.5,6.)
       CALL PLOTG(X,QA2,NLP2,1,1,0,KAP,32,'QA2',3,0.,0.,0.,0.,8.5,6.)
       CALL PLOT(0.0,0.0,999)
       STOP
       END
/*
//GO.SYSIN  DD  *
```

```
//AMIC3250 JOB (3250,0258),'AMICHAI X2936',CLASS=A                                      PRE00010
// EXEC  FRTXCLGP                                                                         PRE00020
//FORT.SYSIN  DD  *                                                                       PRE00030
/*                                                                                        PRE00340
//GO.SYSIN  DD  *                                                                         PRE00350
    1       //AMIC3250 JOB (3250,0258),'AMICHAI X2936',CLASS=A                                      PRE00010
    2       // EXEC  FRTXCLGP                                                                         PRE00020
            *** CCC: THIS IS THE FORTRAN IV H EXTENDED PROCEDURE THAT IS A                            00010000
            ***         COMPILE, LINK-EDIT AND EXECUTE  WITH PLOTTER                                  00020001
            ***                                                                                       00030000
    3       XXFRTXCLG          PROC IMSL=SP                                                           00040014
    4       XXFORT    EXEC  PGM=IFEAAB,REGION=640K                                                    00050014
    5       XXSYSPRINT DD   SYSOUT=*                                                                  00060006
    6       XXSYSTERM  DD   DUMMY                                                                     00070000
    7       XXSYSUT1   DD   UNIT=SYSDA,SPACE=(CYL,(1,2)),DCB=BLKSIZE=3465                             00080014
    8       XXSYSUT2   DD   UNIT=SYSDA,SPACE=(CYL,(2,2)),DCB=BLKSIZE=2048                             00090014
    9       XXSYSLIN   DD   DSN=&OBJ,SPACE=(3040,(40,40)),UNIT=SYSDA,                                +00100000
            XX              DISP=(MOD,PASS),                                                         +00110000
            XX              DCB=(BLKSIZE=3040,LRECL=80,RECFM=FBS,BUFNO=1)                             00120000
   10       //FORT.SYSIN  DD  *,DCB=BLKSIZE=80                                                        PRE00030
   11       XXLKED    EXEC  PGM=IEWL,COND=(9,LT,FORT)                                                 00130017
   12       XXSYSPRINT DD   SYSOUT=*                                                                  00140006
   13       XXSYSLMOD  DD   SPACE=(CYL,(4,4,1)),DSN=&LOD(X),DISP=(,PASS),                            +00150007
            XX              UNIT=SYSDA,DCB=BUFNO=1                                                    00160000
   14       XXSYSUT1   DD   DSN=&SYSUT1,SPACE=(1024,(120,120)),UNIT=SYSDA,                           +00170000
            XX              DCB=BUFNO=1                                                               00180000
   15       XXSYSLIN   DD   DSN=&OBJ,DISP=(OLD,DELETE)                                                00190000
   16       XX         DD   DSN=SYS1.PROCLIB(VMAPP),DISP=SHR                                          00200002
   17       XX         DD   DDNAME=SYSIN                                                              00210003
   18       XXSYSLIB   DD   UNIT=3350,DISP=SHR,VOL=SER=MVS002,DSN=SYS1.PP.FORTLIB                     00220016
   19       XX         DD   UNIT=3350,DISP=SHR,VOL=SER=MVS003,DSN=SYS1.MPSLIB                         00230014
   20       XX         DD   UNIT=3350,DISP=SHR,VOL=SER=MVS003,DSN=SYS3.IMSL.&IMSL                     00240015
   21       XX         DD   UNIT=3350,DISP=SHR,VOL=SER=MVS003,DSN=SYS1.VTECPLOT                       00250014
   22       XXGO      EXEC  PGM=*.LKED.SYSLMOD,COND=((5,LT,LKED),(5,LT,FORT))                         00260014
   23       XXFT05F001 DD   DDNAME=SYSIN                                                              00270000
   24       XXFT06F001 DD   SYSOUT=*                                                                  00280006
   25       XXFT07F001 DD   SYSOUT=B                                                                  00290000
   26       XXVECTR1   DD   DSN=&&VECTR1,DISP=(,PASS),SPACE=(TRK,(1,1)),UNIT=SYSDA                    00300009
   27       XXVECTR2   DD   DSN=&&VECTR2,DISP=(,PASS),SPACE=(CYL,(5,5)),UNIT=SYSDA                    00310009
   28       XXPLOTLOG  DD   SYSOUT=*                                                                  00320009
   29       XXFT15F001 DD   DDNAME=PLOTPARM                                                           00330009
   30       //GO.SYSIN  DD  *,DCB=BLKSIZE=80                                                          PRE00350
   31       XXPLOT    EXEC  PGM=IFVMAPP,COND=(4,LT)                                                   00340009
   32       XXSTEPLIB  DD   UNIT=3350,DISP=SHR,VOL=SER=MVS003,DSN=SYS1.VTECPLOT                       00350014
   33       XXPLOTLOG  DD   SYSOUT=*                                                                  00360009
   34       XXSYSVECTR DD   SYSOUT=(A,,5555)                                                          00370009
   35       XXVECTR1   DD   DISP=(OLD,DELETE),DSN=&&VECTR1                                            00380009
   36       XXVECTR2   DD   DISP=(OLD,DELETE),DSN=&&VECTR2                                            00390009
   37       XXVECTTAPE DD   DUMMY                                                                     00400009
```

```
FILE: CHARTS    EXEC      A    NAVAL POSTGRADUATE SCHOOL

&CONTROL ERROR
&IF .&1 EQ .PRINTER &GOTO -PRINTER
&IF .&1 EQ .PLOTTER &GOTO -PLOTTER
&TYPE REPEAT. SPECIFY PRINTER OR PLOTTER.
&EXIT
-PRINTER &CONTINUE
&NAME = PREPLOTP
&GOTO -DO
-PLOTTER &CONTINUE
&NAME = PREPLOTG
-DO &CONTINUE
COPYFILE &NAME FORTRAN A FILE FT01F001 A PLOT FORTRAN A (REPLACE
EXEC SUBMIT PLOT FORTRAN
```

G4. Results from AERO/COWL

G4.1 The symbols used in programs AERO and COWL are defined in AERO and are presented in Figure G4.1. The values of a, b_1, c_1, b_2, c_2 are normalized with respect to r_1. NA, NB, NC, NB_2, NC_2 are the appropriate numbers of points used in the program. The cowl angles α_1 , α_2 were selected as 20^0, 9.5^0, respectively.

To create flow at the first cowl in Figure G4.1 which is the same as for a ramjet inlet, an extension to the body was used. The extension consists of the cone of length a and cylinder of length b_1 in Figure G4.1. The cone angle, β_1, is 8 degrees. The value of b_1 was varied until the pressure at the first cowl was equal to ambient; a value of b_1 equal to $7r_1$ gives this condition.

G4.2 The normalized values of the various variables which were selected are as follow:

$$a = 7.11 \ , \ b_1 = 7. \ , \ c_1 = 0.2 \ , \ b_2 = 2.13 \ , \ c_2 = 1.06 \text{ units}$$

$$- DL = 0.0736, \ - DL_2 = 0.177 \text{ units.}$$

The appropriate numbers of points are:

$$NA = 203, \ NB = 200, \ NC = 6, \ NB_2 = 61, \ NC_2 = 30$$

The dimensional values are:

$$c_1 = 0.40, \ b_2 = 4.22, \ c_2 = 2.1 \text{ inch}$$

$$r_1 = 1.98, \ r_2 = 2.13, \ r_3 = 2.48 \text{ inch}$$

G4.3 It was found that the cowl drag coefficient is sensitive to the magnitude of projected cowl area. For example, another combination of these variables:

$a = 7.11$, $b_1 = 7.$, $c_1 = 0.38$, $b_2 = 2.16$, $c_2 = 1.46$

$NA = 196$, $NB = 193$, $NC = 11$, $NB_2 = 60$, $NC_2 = 40$

$-DL = 0.138(20^o)$, $-DL_2 = 0.243\ (9.5^o)$

Gives higher values of the cowl drag coefficient:

Mo	3.0	2.3
G4.2	0.0732	0.0953
G4.3	0.1214	0.1562

Therefore, attention was made to select an inlet shape as smooth as possible.

G4.4 AERO can produce also graphical results. A typical example is illustrated in Figure G4.2.

G4.5 <u>Computer Program Users Guide</u>

Use opening commands and compilation similar to that defined in F2.1, F2.2.

The routine to run AERO on the terminal is defined in program itself.

The routine to run COWL on the terminal is as follows:

```
FILEDEF 02 DISK OUT D (RECFM F BLØCK 132 PERM
EXEC RUN COWL
PRINT OUT D  } optional
XEDIT OUT D  }
```

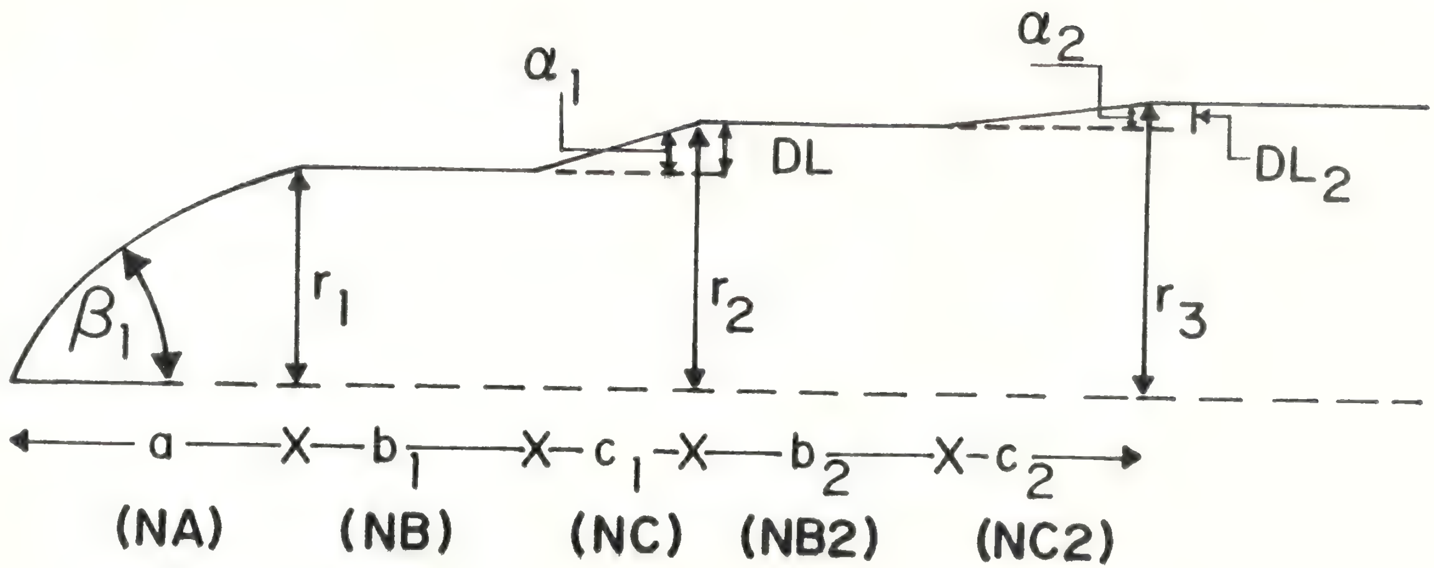

Figure G4.1 Geometry for Calculation of Cowl-Drag-Coefficient (Programs AERO & COWL) Showing Definition of Symbols

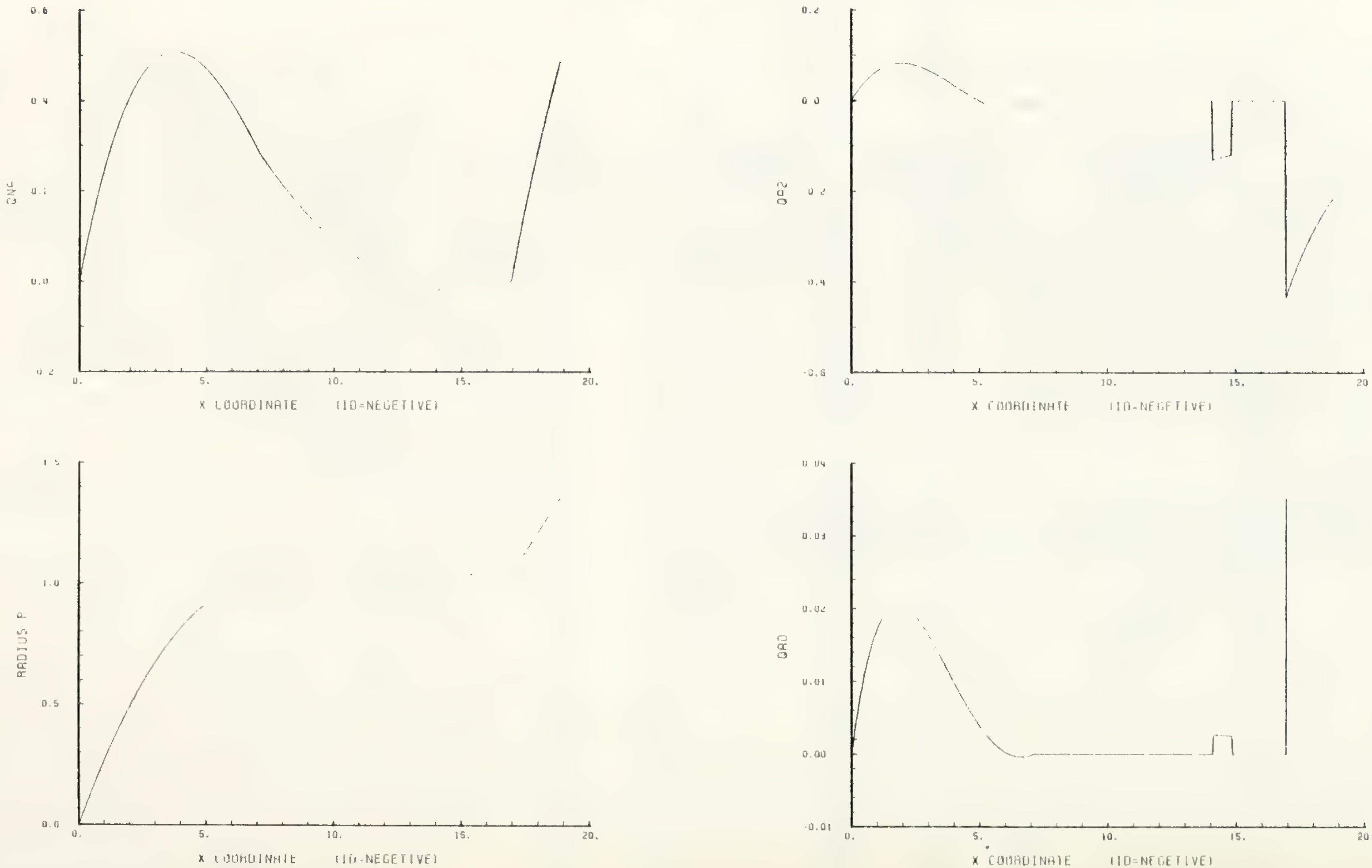

Figure G4.2 Typical Results from AERO

XM=3.0, XL=18.88, NL=500, NA=188, NB=185, NC=20, NB2=56, NC2=51

APPENDIX H: RESULTS

H1. SUMMARY

A_0/A_r	A_5/A_r	A_1/A_0	A_2/A_0	A_3/A_r	θ_p	θ
0.25-0.40	0.25-0.40	0.47	0.887	0.426	9.5	15
						25
						35
						40
						45
						65
						80
0.25-0.40	0.25-0.40	0.50	0.827	0.426	9.5	7
						25
						45
						65
						80
0.25-0.40	0.25-0.40	0.42	0.827	0.426	9.5	45
		0.58				
0.25-0.40	0.25-0.40	0.47	0.75	0.426	9.5	45
			0.827			
			0.91			
0.25-0.40	0.25-0.40	0.47	0.827	0.27	9.5	45
				0.32		
				0.47		
0.25-0.40	0.25-0.40	0.47	0.827	0.426	6.5	45
					11.5	

1 SOLID FUEL RAMJET & TRAJECTORY

SUMMARY

AO/AP	AS/AR	TOB	XOB	YOB	TOF	X(MAX)	Y(MAX)	TETP	TETA
0.250E+00	0.250E+00	0.326E+02	0.256E+05	0.165E+04	0.440E+02	0.331E+05	-0.240E+02	0.950E+01	0.150E+02
0.260E+00	0.250E+00	0.320E+02	0.255E+05	0.179E+04	0.446E+02	0.338E+05	-0.219E+02	0.950E+01	0.150E+02
0.270E+00	0.250E+00	0.314E+02	0.251E+05	0.186E+04	0.447E+02	0.340E+05	-0.190E+02	0.950E+01	0.150E+02
0.280E+00	0.250E+00	0.310E+02	0.249E+05	0.193E+04	0.450E+02	0.343E+05	-0.336E+01	0.950E+01	0.150E+02
0.290E+00	0.250E+00	0.303E+02	0.245E+05	0.202E+04	0.454E+02	0.346E+05	-0.283E+02	0.950E+01	0.150E+02
0.300E+00	0.250E+00	0.195E+02	0.132E+05	0.188E+04	0.197E+02	0.132E+05	0.188E+04	0.950E+01	0.150E+02
0.310E+00	0.250E+00	0.173E+02	0.117E+05	0.182E+04	0.175E+02	0.117E+05	0.182E+04	0.950E+01	0.150E+02
0.320E+00	0.250E+00	0.177E+02	0.121E+05	0.185E+04	0.179E+02	0.121E+05	0.185E+04	0.950E+01	0.150E+02
0.330E+00	0.250E+00	0.177E+02	0.121E+05	0.185E+04	0.179E+02	0.121E+05	0.185E+04	0.950E+01	0.150E+02
0.340E+00	0.250E+00	0.177E+02	0.121E+05	0.185E+04	0.179E+02	0.121E+05	0.185E+04	0.950E+01	0.150E+02
0.350E+00	0.250E+00	0.177E+02	0.121E+05	0.185E+04	0.179E+02	0.121E+05	0.185E+04	0.950E+01	0.150E+02
0.360E+00	0.250E+00	0.177E+02	0.121E+05	0.185E+04	0.179E+02	0.121E+05	0.185E+04	0.950E+01	0.150E+02
0.370E+00	0.250E+00	0.177E+02	0.121E+05	0.185E+04	0.179E+02	0.121E+05	0.185E+04	0.950E+01	0.150E+02
0.380E+00	0.250E+00	0.177E+02	0.121E+05	0.185E+04	0.179E+02	0.121E+05	0.185E+04	0.950E+01	0.150E+02
0.390E+00	0.250E+00	0.177E+02	0.121E+05	0.185E+04	0.179E+02	0.121E+05	0.185E+04	0.950E+01	0.150E+02
0.400E+00	0.250E+00	0.177E+02	0.121E+05	0.185E+04	0.179E+02	0.121E+05	0.185E+04	0.950E+01	0.150E+02
0.250E+00	0.260E+00	0.323E+02	0.252E+05	0.163E+04	0.437E+02	0.327E+05	-0.216E+02	0.950E+01	0.150E+02
0.260E+00	0.260E+00	0.320E+02	0.253E+05	0.175E+04	0.442E+02	0.334E+05	-0.127E+02	0.950E+01	0.150E+02
0.270E+00	0.260E+00	0.314E+02	0.250E+05	0.181E+04	0.444E+02	0.336E+05	-0.185E+02	0.950E+01	0.150E+02
0.280E+00	0.260E+00	0.307E+02	0.246E+05	0.191E+04	0.446E+02	0.338E+05	0.935E+01	0.950E+01	0.150E+02
0.290E+00	0.260E+00	0.303E+02	0.244E+05	0.198E+04	0.451E+02	0.342E+05	-0.250E+02	0.950E+01	0.150E+02
0.300E+00	0.260E+00	0.298E+02	0.241E+05	0.205E+04	0.453E+02	0.344E+05	-0.131E+02	0.950E+01	0.150E+02
0.310E+00	0.260E+00	0.191E+02	0.130E+05	0.186E+04	0.194E+02	0.130E+05	0.186E+04	0.950E+01	0.150E+02
0.320E+00	0.260E+00	0.171E+02	0.116E+05	0.180E+04	0.174E+02	0.116E+05	0.180E+04	0.950E+01	0.150E+02
0.330E+00	0.260E+00	0.175E+02	0.119E+05	0.183E+04	0.178E+02	0.119E+05	0.183E+04	0.950E+01	0.150E+02
0.340E+00	0.260E+00	0.175E+02	0.119E+05	0.183E+04	0.178E+02	0.119E+05	0.183E+04	0.950E+01	0.150E+02
0.350E+00	0.260E+00	0.175E+02	0.119E+05	0.183E+04	0.178E+02	0.119E+05	0.183E+04	0.950E+01	0.150E+02
0.360E+00	0.260E+00	0.175E+02	0.119E+05	0.183E+04	0.178E+02	0.119E+05	0.183E+04	0.950E+01	0.150E+02
0.370E+00	0.260E+00	0.175E+02	0.119E+05	0.183E+04	0.178E+02	0.119E+05	0.183E+04	0.950E+01	0.150E+02
0.380E+00	0.260E+00	0.175E+02	0.119E+05	0.183E+04	0.178E+02	0.119E+05	0.183E+04	0.950E+01	0.150E+02
0.390E+00	0.260E+00	0.175E+02	0.119E+05	0.183E+04	0.178E+02	0.119E+05	0.183E+04	0.950E+01	0.150E+02
0.400E+00	0.260E+00	0.175E+02	0.119E+05	0.183E+04	0.178E+02	0.119E+05	0.183E+04	0.950E+01	0.150E+02

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INPUT DATA:

0.400 0.260 0.470 0.687 0.426

9.5 15.0 0 -2 1.800 0.930 0.930 0.960

FILE: CNR . D A NAVAL POSTGRADUATE SCHOOL PAGE 001

1 SOLID FUEL-RAMJET & TRAJECTORY

SUMMARY

AO/AR	A5/AR	TOB	XOB	YOB	TOF	X(MAX)	Y(MAX)	TETP	TETA
0.250E+00	0.250E+00	0.442E+02	0.346E+05	0.613E+04	0.700E+02	0.510E+05	0.177E+04	0.950E+01	0.250E+02
0.260E+00	0.250E+00	0.440E+02	0.349E+05	0.633E+04	0.739E+02	0.538E+05	0.994E+03	0.950E+01	0.250E+02
0.270E+00	0.250E+00	0.431E+02	0.344E+05	0.646E+04	0.738E+02	0.540E+05	0.116E+04	0.950E+01	0.250E+02
0.280E+00	0.250E+00	0.427E+02	0.344E+05	0.659E+04	0.745E+02	0.548E+05	0.116E+04	0.950E+01	0.250E+02
0.290E+00	0.250E+00	0.423E+02	0.343E+05	0.671E+04	0.753E+02	0.557E+05	0.113E+04	0.950E+01	0.250E+02
0.300E+00	0.250E+00	0.191E+02	0.126E+05	0.420E+04	0.195E+02	0.126E+05	0.420E+04	0.950E+01	0.250E+02
0.310E+00	0.250E+00	0.171E+02	0.112E+05	0.389E+04	0.174E+02	0.112E+05	0.389E+04	0.950E+01	0.250E+02
0.320E+00	0.250E+00	0.176E+02	0.116E+05	0.399E+04	0.180E+02	0.116E+05	0.399E+04	0.950E+01	0.250E+02
0.330E+00	0.250E+00	0.176E+02	0.116E+05	0.399E+04	0.180E+02	0.116E+05	0.399E+04	0.950E+01	0.250E+02
0.340E+00	0.250E+00	0.176E+02	0.116E+05	0.399E+04	0.180E+02	0.116E+05	0.399E+04	0.950E+01	0.250E+02
0.350E+00	0.250E+00	0.176E+02	0.116E+05	0.399E+04	0.180E+02	0.116E+05	0.399E+04	0.950E+01	0.250E+02
0.360E+00	0.250E+00	0.176E+02	0.116E+05	0.399E+04	0.180E+02	0.116E+05	0.399E+04	0.950E+01	0.250E+02
0.370E+00	0.250E+00	0.176E+02	0.116E+05	0.399E+04	0.180E+02	0.116E+05	0.399E+04	0.950E+01	0.250E+02
0.380E+00	0.250E+00	0.176E+02	0.116E+05	0.399E+04	0.180E+02	0.116E+05	0.399E+04	0.950E+01	0.250E+02
0.390E+00	0.250E+00	0.176E+02	0.116E+05	0.399E+04	0.180E+02	0.116E+05	0.399E+04	0.950E+01	0.250E+02
0.400E+00	0.250E+00	0.176E+02	0.116E+05	0.399E+04	0.180E+02	0.116E+05	0.399E+04	0.950E+01	0.250E+02
0.250E+00	0.260E+00	0.439E+02	0.342E+05	0.605E+04	0.692E+02	0.502E+05	0.184E+04	0.950E+01	0.250E+02
0.260E+00	0.260E+00	0.436E+02	0.343E+05	0.625E+04	0.729E+02	0.529E+05	0.110E+04	0.950E+01	0.250E+02
0.270E+00	0.260E+00	0.431E+02	0.342E+05	0.636E+04	0.732E+02	0.534E+05	0.116E+04	0.950E+01	0.250E+02
0.280E+00	0.260E+00	0.424E+02	0.339E+05	0.652E+04	0.732E+02	0.530E+05	0.135E+04	0.950E+01	0.250E+02
0.290E+00	0.260E+00	0.420E+02	0.339E+05	0.664E+04	0.740E+02	0.545E+05	0.133E+04	0.950E+01	0.250E+02
0.300E+00	0.260E+00	0.413E+02	0.335E+05	0.676E+04	0.744E+02	0.550E+05	0.140E+04	0.950E+01	0.250E+02
0.310E+00	0.260E+00	0.199E+02	0.124E+05	0.415E+04	0.193E+02	0.124E+05	0.415E+04	0.950E+01	0.250E+02
0.320E+00	0.260E+00	0.169E+02	0.111E+05	0.384E+04	0.173E+02	0.111E+05	0.384E+04	0.950E+01	0.250E+02
0.330E+00	0.260E+00	0.171E+02	0.113E+05	0.390E+04	0.175E+02	0.113E+05	0.390E+04	0.950E+01	0.250E+02
0.340E+00	0.260E+00	0.171E+02	0.113E+05	0.390E+04	0.175E+02	0.113E+05	0.390E+04	0.950E+01	0.250E+02
0.350E+00	0.260E+00	0.171E+02	0.113E+05	0.390E+04	0.175E+02	0.113E+05	0.390E+04	0.950E+01	0.250E+02
0.360E+00	0.260E+00	0.171E+02	0.113E+05	0.390E+04	0.175E+02	0.113E+05	0.390E+04	0.950E+01	0.250E+02
0.370E+00	0.260E+00	0.171E+02	0.113E+05	0.390E+04	0.175E+02	0.113E+05	0.390E+04	0.950E+01	0.250E+02
0.380E+00	0.260E+00	0.171E+02	0.113E+05	0.390E+04	0.175E+02	0.113E+05	0.390E+04	0.950E+01	0.250E+02
0.390E+00	0.260E+00	0.171E+02	0.113E+05	0.390E+04	0.175E+02	0.113E+05	0.390E+04	0.950E+01	0.250E+02
0.400E+00	0.260E+00	0.171E+02	0.113E+05	0.390E+04	0.175E+02	0.113E+05	0.390E+04	0.950E+01	0.250E+02

1+++++++++++++++++++++++++++++ 20+++++++++++++++++++++++++++

INPUT DATA:

0.400 0.260 0.470 0.897 0.426

9.5 25.0 0 -2 1.800 0.930 0.930 0.960

FILE: CMB   D   A   NAVAL POSTGRADUATE SCHOOL   PAGE 001

1   SOLID FUEL RAMJET & TRAJECTORY

SUMMARY

AO/AR	A5/AR	TOB	XOB	YOB	TOF	X(MAX)	Y(MAX)	TETP	TETA
0.250E+00	0.250E+00	0.676E+02	0.507E+05	0.115E+05	0.108E+03	0.757E+05	-0.264E+02	0.950E+01	0.350E+02
0.260E+00	0.250E+00	0.684E+02	0.519E+05	0.118E+05	0.109E+03	0.777E+05	-0.352E+02	0.950E+01	0.350E+02
0.270E+00	0.250E+00	0.681E+02	0.522E+05	0.121E+05	0.110E+03	0.794E+05	-0.120E+03	0.950E+01	0.350E+02
0.280E+00	0.250E+00	0.681E+02	0.524E+05	0.125E+05	0.111E+03	0.810E+05	-0.602E+02	0.950E+01	0.350E+02
0.290E+00	0.250E+00	0.686E+02	0.538E+05	0.127E+05	0.112E+03	0.828E+05	-0.363E+02	0.950E+01	0.350E+02
0.300E+00	0.250E+00	0.188E+02	0.116E+05	0.641E+04	0.193E+02	0.116E+05	0.641E+04	0.950E+01	0.350E+02
0.310E+00	0.250E+00	0.166E+02	0.102E+05	0.581E+04	0.171E+02	0.102E+05	0.581E+04	0.950E+01	0.350E+02
0.320E+00	0.250E+00	0.173E+02	0.106E+05	0.601E+04	0.178E+02	0.106E+05	0.601E+04	0.950E+01	0.350E+02
0.330E+00	0.250E+00	0.173E+02	0.106E+05	0.601E+04	0.178E+02	0.106E+05	0.601E+04	0.950E+01	0.350E+02
0.340E+00	0.250E+00	0.173E+02	0.106E+05	0.601E+04	0.178E+02	0.106E+05	0.601E+04	0.950E+01	0.350E+02
0.350E+00	0.250E+00	0.173E+02	0.106E+05	0.601E+04	0.178E+02	0.106E+05	0.601E+04	0.950E+01	0.350E+02
0.360E+00	0.250E+00	0.173E+02	0.106E+05	0.601E+04	0.178E+02	0.106E+05	0.601E+04	0.950E+01	0.350E+02
0.370E+00	0.250E+00	0.173E+02	0.106E+05	0.601E+04	0.178E+02	0.106E+05	0.601E+04	0.950E+01	0.350E+02
0.380E+00	0.250E+00	0.173E+02	0.106E+05	0.601E+04	0.178E+02	0.106E+05	0.601E+04	0.950E+01	0.350E+02
0.390E+00	0.250E+00	0.173E+02	0.106E+05	0.601E+04	0.178E+02	0.106E+05	0.601E+04	0.950E+01	0.350E+02
0.400E+00	0.250E+00	0.173E+02	0.106E+05	0.601E+04	0.179E+02	0.105E+05	0.601E+04	0.950E+01	0.350E+02
0.250E+00	0.260E+00	0.671E+02	0.501E+05	0.114E+05	0.108E+03	0.742E+05	-0.157E+03	0.950E+01	0.350E+02
0.260E+00	0.260E+00	0.674E+02	0.508E+05	0.117E+05	0.109E+03	0.769E+05	-0.134E+03	0.950E+01	0.350E+02
0.270E+00	0.260E+00	0.676E+02	0.516E+05	0.120E+05	0.110E+03	0.784E+05	-0.474E+02	0.950E+01	0.350E+02
0.280E+00	0.260E+00	0.676E+02	0.522E+05	0.123E+05	0.111E+03	0.803E+05	-0.173E+03	0.950E+01	0.350E+02
0.290E+00	0.260E+00	0.681E+02	0.531E+05	0.126E+05	0.112E+03	0.819E+05	-0.145E+03	0.950E+01	0.350E+02
0.300E+00	0.260E+00	0.681E+02	0.547E+05	0.129E+05	0.113E+03	0.835E+05	-0.127E+03	0.950E+01	0.350E+02
0.310E+00	0.260E+00	0.187E+02	0.114E+05	0.632E+04	0.192E+02	0.114E+05	0.632E+04	0.950E+01	0.350E+02
0.320E+00	0.260E+00	0.165E+02	0.101E+05	0.574E+04	0.170E+02	0.101E+05	0.574E+04	0.950E+01	0.350E+02
0.330E+00	0.260E+00	0.172E+02	0.105E+05	0.594E+04	0.177E+02	0.105E+05	0.594E+04	0.950E+01	0.350E+02
0.340E+00	0.260E+00	0.172E+02	0.105E+05	0.594E+04	0.177E+02	0.105E+05	0.594E+04	0.950E+01	0.350E+02
0.350E+00	0.260E+00	0.172E+02	0.105E+05	0.594E+04	0.177E+02	0.105E+05	0.594E+04	0.950E+01	0.350E+02
0.360E+00	0.260E+00	0.172E+02	0.105E+05	0.594E+04	0.177E+02	0.105E+05	0.594E+04	0.950E+01	0.350E+02
0.370E+00	0.260E+00	0.172E+02	0.105E+05	0.594E+04	0.177E+02	0.105E+05	0.594E+04	0.950E+01	0.350E+02
0.380E+00	0.260E+00	0.172E+02	0.105E+05	0.594E+04	0.177E+02	0.105E+05	0.594E+04	0.950E+01	0.350E+02
0.390E+00	0.260E+00	0.172E+02	0.105E+05	0.594E+04	0.177E+02	0.105E+05	0.594E+04	0.950E+01	0.350E+02
0.400E+00	0.260E+00	0.172E+02	0.105E+05	0.594E+04	0.177E+02	0.105E+05	0.594E+04	0.950E+01	0.350E+02

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INPUT DATA:

0.400   0.260   0.479   0.497   0.426

9.5 35.0 0 -2 1.800 0.930 0.930 0.960

FILE: CMB D A NAVAL POSTGRADUATE SCHOOL PAGE 001

1 SOLID FUEL RAMJET & TRAJECTORY

SUMMARY

AO/AR	A5/AR	TOB	XOB	YOB	TOF	X(MAX)	Y(MAX)	TETP	TETA
0.250E+00	0.250E+00	0.416E+02	0.286E+05	0.150E+05	0.121E+03	0.744E+05	-0.111E+02	0.950E+01	0.400E+02
0.260E+00	0.250E+00	0.378E+02	0.262E+05	0.145E+05	0.122E+03	0.749E+05	-0.166E+03	0.950E+01	0.400E+02
0.270E+00	0.250E+00	0.359E+02	0.250E+05	0.142E+05	0.122E+03	0.756E+05	-0.334E+02	0.950E+01	0.400E+02
0.280E+00	0.250E+00	0.330E+02	0.231E+05	0.137E+05	0.123E+03	0.756E+05	-0.137E+03	0.950E+01	0.400E+02
0.290E+00	0.250E+00	0.296E+02	0.238E+05	0.128E+05	0.123E+03	0.748E+05	-0.216E+03	0.950E+01	0.400E+02
0.300E+00	0.250E+00	0.177E+02	0.103E+05	0.714E+04	0.182E+02	0.103E+05	0.714E+04	0.950E+01	0.400E+02
0.310E+00	0.250E+00	0.170E+02	0.988E+04	0.688E+04	0.176E+02	0.988E+04	0.688E+04	0.950E+01	0.400E+02
0.320E+00	0.250E+00	0.171E+02	0.997E+04	0.695E+04	0.177E+02	0.997E+04	0.695E+04	0.950E+01	0.400E+02
0.330E+00	0.250E+00	0.171E+02	0.997E+04	0.695E+04	0.177E+02	0.997E+04	0.695E+04	0.950E+01	0.400E+02
0.340E+00	0.250E+00	0.171E+02	0.997E+04	0.695E+04	0.177E+02	0.997E+04	0.695E+04	0.950E+01	0.400E+02
0.350E+00	0.250E+00	0.171E+02	0.997E+04	0.695E+04	0.177E+02	0.997E+04	0.695E+04	0.950E+01	0.400E+02
0.360E+00	0.250E+00	0.171E+02	0.997E+04	0.695E+04	0.177E+02	0.997E+04	0.695E+04	0.950E+01	0.400E+02
0.370E+00	0.250E+00	0.171E+02	0.997E+04	0.695E+04	0.177E+02	0.997E+04	0.695E+04	0.950E+01	0.400E+02
0.380E+00	0.250E+00	0.171E+02	0.997E+04	0.695E+04	0.177E+02	0.997E+04	0.695E+04	0.950E+01	0.400E+02
0.390E+00	0.250E+00	0.171E+02	0.997E+04	0.695E+04	0.177E+02	0.997E+04	0.695E+04	0.950E+01	0.400E+02
0.400E+00	0.250E+00	0.171E+02	0.997E+04	0.695E+04	0.177E+02	0.997E+04	0.695E+04	0.950E+01	0.400E+02
0.250E+00	0.260E+00	0.320E+02	0.584E+05	0.136E+05	0.122E+03	0.824E+05	-0.138E+03	0.950E+01	0.400E+02
0.260E+00	0.260E+00	0.463E+02	0.322E+05	0.158E+05	0.122E+03	0.776E+05	-0.118E+03	0.950E+01	0.400E+02
0.270E+00	0.260E+00	0.479E+02	0.337E+05	0.162E+05	0.124E+03	0.797E+05	-0.583E+02	0.950E+01	0.400E+02
0.280E+00	0.260E+00	0.430E+02	0.304E+05	0.158E+05	0.124E+03	0.797E+05	-0.154E+02	0.950E+01	0.400E+02
0.290E+00	0.260E+00	0.396E+02	0.231E+05	0.153E+05	0.126E+03	0.802E+05	-0.227E+03	0.950E+01	0.400E+02
0.300E+00	0.260E+00	0.368E+02	0.262E+05	0.148E+05	0.126E+03	0.801E+05	-0.415E+02	0.950E+01	0.400E+02
0.310E+00	0.260E+00	0.175E+02	0.102E+05	0.705E+04	0.131E+02	0.102E+05	0.705E+04	0.950E+01	0.400E+02
0.320E+00	0.260E+00	0.163E+02	0.949E+04	0.666E+04	0.169E+02	0.949E+04	0.666E+04	0.950E+01	0.400E+02
0.330E+00	0.260E+00	0.170E+02	0.984E+04	0.686E+04	0.175E+02	0.984E+04	0.686E+04	0.950E+01	0.400E+02
0.340E+00	0.260E+00	0.170E+02	0.984E+04	0.686E+04	0.175E+02	0.984E+04	0.686E+04	0.950E+01	0.400E+02
0.350E+00	0.260E+00	0.170E+02	0.984E+04	0.686E+04	0.175E+02	0.984E+04	0.686E+04	0.950E+01	0.400E+02
0.360E+00	0.260E+00	0.170E+02	0.984E+04	0.686E+04	0.175E+02	0.984E+04	0.686E+04	0.950E+01	0.400E+02
0.370E+00	0.260E+00	0.170E+02	0.984E+04	0.686E+04	0.175E+02	0.984E+04	0.686E+04	0.950E+01	0.400E+02
0.380E+00	0.260E+00	0.170E+02	0.984E+04	0.686E+04	0.175E+02	0.984E+04	0.686E+04	0.950E+01	0.400E+02
0.390E+00	0.260E+00	0.170E+02	0.984E+04	0.686E+04	0.175E+02	0.984E+04	0.686E+04	0.950E+01	0.400E+02
0.400E+00	0.260E+00	0.170E+02	0.984E+04	0.686E+04	0.175E+02	0.984E+04	0.686E+04	0.950E+01	0.400E+02

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INPUT DATA:

0.400 0.260 0.670 0.897 0.426

9.5 40.0 0 -2 1.800 0.930 0.930 0.960

FILE: CMB D A NAVAL POSTGRADUATE SCHOOL PAGE 001

1 SOLID FUEL-RAMJET & TRAJECTORY

SUMMARY

AO/AP	A5/AP	TOB	XOB	YOB	TOF	X(MAX)	Y(MAX)	TETP	TETA
0.250E+00	0.250E+00	0.269E+02	0.169E+05	0.132E+05	0.129E+03	0.697E+05	-0.768E+02	0.950E+01	0.450E+02
0.260E+00	0.250E+00	0.252E+02	0.159E+05	0.126E+05	0.130E+03	0.705E+05	-0.198E+03	0.950E+01	0.450E+02
0.270E+00	0.250E+00	0.238E+02	0.152E+05	0.122E+05	0.130E+03	0.706E+05	-0.425E+02	0.950E+01	0.450E+02
0.280E+00	0.250E+00	0.219E+02	0.140E+05	0.115E+05	0.130E+03	0.702E+05	-0.112E+03	0.950E+01	0.450E+02
0.290E+00	0.250E+00	0.194E+02	0.125E+05	0.105E+05	0.128E+03	0.684E+05	-0.660E+02	0.950E+01	0.450E+02
0.300E+00	0.250E+00	0.175E+02	0.957E+04	0.805E+04	0.182E+02	0.957E+04	0.805E+04	0.950E+01	0.450E+02
0.310E+00	0.250E+00	0.168E+02	0.917E+04	0.776E+04	0.175E+02	0.917E+04	0.776E+04	0.950E+01	0.450E+02
0.320E+00	0.250E+00	0.169E+02	0.924E+04	0.782E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.330E+00	0.250E+00	0.169E+02	0.924E+04	0.782E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.340E+00	0.250E+00	0.169E+02	0.924E+04	0.782E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.350E+00	0.250E+00	0.169E+02	0.924E+04	0.782E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.360E+00	0.250E+00	0.169E+02	0.924E+04	0.782E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.370E+00	0.250E+00	0.169E+02	0.924E+04	0.782E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.380E+00	0.250E+00	0.169E+02	0.924E+04	0.782E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.390E+00	0.250E+00	0.169E+02	0.924E+04	0.782E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.400E+00	0.250E+00	0.169E+02	0.924E+04	0.782E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.250E+00	0.260E+00	0.299E+02	0.187E+05	0.141E+05	0.130E+03	0.712E+05	-0.195E+03	0.950E+01	0.450E+02
0.260E+00	0.260E+00	0.294E+02	0.186E+05	0.141E+05	0.131E+03	0.729E+05	-0.245E+03	0.950E+01	0.450E+02
0.270E+00	0.260E+00	0.280E+02	0.178E+05	0.137E+05	0.132E+03	0.737E+05	-0.227E+03	0.950E+01	0.450E+02
0.290E+00	0.260E+00	0.268E+02	0.172E+05	0.134E+05	0.133E+03	0.744E+05	-0.220E+03	0.950E+01	0.450E+02
0.290E+00	0.260E+00	0.249E+02	0.160E+05	0.124E+05	0.133E+03	0.742E+05	-0.172E+03	0.950E+01	0.450E+02
0.300E+00	0.260E+00	0.230E+02	0.149E+05	0.121E+05	0.133E+03	0.739E+05	-0.253E+03	0.950E+01	0.450E+02
0.310E+00	0.260E+00	0.168E+02	0.917E+04	0.777E+04	0.174E+02	0.917E+04	0.777E+04	0.950E+01	0.450E+02
0.320E+00	0.260E+00	0.161E+02	0.877E+04	0.748E+04	0.167E+02	0.877E+04	0.749E+04	0.950E+01	0.450E+02
0.330E+00	0.260E+00	0.162E+02	0.884E+04	0.754E+04	0.168E+02	0.884E+04	0.754E+04	0.950E+01	0.450E+02
0.340E+00	0.260E+00	0.162E+02	0.884E+04	0.754E+04	0.168E+02	0.884E+04	0.754E+04	0.950E+01	0.450E+02
0.350E+00	0.260E+00	0.162E+02	0.884E+04	0.754E+04	0.168E+02	0.884E+04	0.754E+04	0.950E+01	0.450E+02
0.360E+00	0.260E+00	0.162E+02	0.884E+04	0.754E+04	0.168E+02	0.884E+04	0.754E+04	0.950E+01	0.450E+02
0.370E+00	0.260E+00	0.162E+02	0.884E+04	0.754E+04	0.168E+02	0.884E+04	0.754E+04	0.950E+01	0.450E+02
0.380E+00	0.260E+00	0.162E+02	0.884E+04	0.754E+04	0.168E+02	0.884E+04	0.754E+04	0.950E+01	0.450E+02
0.390E+00	0.260E+00	0.162E+02	0.884E+04	0.754E+04	0.168E+02	0.884E+04	0.754E+04	0.950E+01	0.450E+02
0.400E+00	0.260E+00	0.162E+02	0.884E+04	0.754E+04	0.168E+02	0.884E+04	0.754E+04	0.950E+01	0.450E+02

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INPUT DATA:

0.400 0.260 0.470 0.887 0.426

9.5 45.0 0 -2 1.800 0.930 0.930 0.960

1 SOLID FUEL RAMJET & TRAJECTORY

SUMMARY

AO/AR	A5/AR	TOB	XOB	YOB	TOF	X(MAX)	Y(MAX)	TETP	TETA
0.250E+00	0.250E+00	0.161E+02	0.613E+04	0.118E+05	0.361E+02	0.133E+05	0.220E+05	0.950E+01	0.650E+02
0.260E+00	0.250E+00	0.153E+02	0.590E+04	0.114E+05	0.371E+02	0.137E+05	0.226E+05	0.950E+01	0.650E+02
0.270E+00	0.250E+00	0.145E+02	0.561E+04	0.109E+05	0.369E+02	0.137E+05	0.226E+05	0.950E+01	0.650E+02
0.280E+00	0.250E+00	0.129E+02	0.503E+04	0.991E+04	0.353E+02	0.130E+05	0.218E+05	0.950E+01	0.650E+02
0.290E+00	0.250E+00	0.112E+02	0.444E+04	0.885E+04	0.337E+02	0.123E+05	0.209E+05	0.950E+01	0.650E+02
0.300E+00	0.250E+00	0.161E+02	0.550E+04	0.104E+05	0.169E+02	0.550E+04	0.104E+05	0.950E+01	0.650E+02
0.310E+00	0.250E+00	0.152E+02	0.523E+04	0.999E+04	0.160E+02	0.523E+04	0.999E+04	0.950E+01	0.650E+02
0.320E+00	0.250E+00	0.161E+02	0.548E+04	0.104E+05	0.169E+02	0.548E+04	0.104E+05	0.950E+01	0.650E+02
0.330E+00	0.250E+00	0.161E+02	0.548E+04	0.104E+05	0.169E+02	0.548E+04	0.104E+05	0.950E+01	0.650E+02
0.340E+00	0.250E+00	0.161E+02	0.548E+04	0.104E+05	0.169E+02	0.548E+04	0.104E+05	0.950E+01	0.650E+02
0.350E+00	0.250E+00	0.161E+02	0.548E+04	0.104E+05	0.169E+02	0.548E+04	0.104E+05	0.950E+01	0.650E+02
0.360E+00	0.250E+00	0.161E+02	0.548E+04	0.104E+05	0.169E+02	0.548E+04	0.104E+05	0.950E+01	0.650E+02
0.370E+00	0.250E+00	0.161E+02	0.548E+04	0.104E+05	0.169E+02	0.548E+04	0.104E+05	0.950E+01	0.650E+02
0.380E+00	0.250E+00	0.161E+02	0.548E+04	0.104E+05	0.169E+02	0.548E+04	0.104E+05	0.950E+01	0.650E+02
0.390E+00	0.250E+00	0.161E+02	0.548E+04	0.104E+05	0.169E+02	0.548E+04	0.104E+05	0.950E+01	0.650E+02
0.400E+00	0.250E+00	0.161E+02	0.548E+04	0.104E+05	0.169E+02	0.548E+04	0.104E+05	0.950E+01	0.650E+02
0.250E+00	0.260E+00	0.175E+02	0.664E+04	0.126E+05	0.367E+02	0.135E+05	0.223E+05	0.950E+01	0.650E+02
0.260E+00	0.260E+00	0.168E+02	0.642E+04	0.123E+05	0.376E+02	0.139E+05	0.229E+05	0.950E+01	0.650E+02
0.270E+00	0.260E+00	0.159E+02	0.614E+04	0.118E+05	0.375E+02	0.139E+05	0.229E+05	0.950E+01	0.650E+02
0.280E+00	0.260E+00	0.152E+02	0.587E+04	0.114E+05	0.383E+02	0.143E+05	0.233E+05	0.950E+01	0.650E+02
0.290E+00	0.260E+00	0.136E+02	0.529E+04	0.104E+05	0.367E+02	0.136E+05	0.226E+05	0.950E+01	0.650E+02
0.300E+00	0.260E+00	0.120E+02	0.471E+04	0.933E+04	0.351E+02	0.129E+05	0.217E+05	0.950E+01	0.650E+02
0.310E+00	0.260E+00	0.159E+02	0.543E+04	0.103E+05	0.167E+02	0.543E+04	0.103E+05	0.950E+01	0.650E+02
0.320E+00	0.260E+00	0.151E+02	0.516E+04	0.986E+04	0.159E+02	0.516E+04	0.986E+04	0.950E+01	0.650E+02
0.330E+00	0.260E+00	0.151E+02	0.519E+04	0.991E+04	0.159E+02	0.519E+04	0.991E+04	0.950E+01	0.650E+02
0.340E+00	0.260E+00	0.151E+02	0.519E+04	0.991E+04	0.159E+02	0.519E+04	0.991E+04	0.950E+01	0.650E+02
0.350E+00	0.260E+00	0.151E+02	0.519E+04	0.991E+04	0.159E+02	0.519E+04	0.991E+04	0.950E+01	0.650E+02
0.360E+00	0.260E+00	0.151E+02	0.519E+04	0.991E+04	0.159E+02	0.519E+04	0.991E+04	0.950E+01	0.650E+02
0.370E+00	0.260E+00	0.151E+02	0.519E+04	0.991E+04	0.159E+02	0.519E+04	0.991E+04	0.950E+01	0.650E+02
0.380E+00	0.260E+00	0.151E+02	0.519E+04	0.991E+04	0.159E+02	0.519E+04	0.991E+04	0.950E+01	0.650E+02
0.390E+00	0.260E+00	0.151E+02	0.519E+04	0.991E+04	0.159E+02	0.519E+04	0.991E+04	0.950E+01	0.650E+02
0.400E+00	0.260E+00	0.151E+02	0.519E+04	0.991E+04	0.159E+02	0.519E+04	0.991E+04	0.950E+01	0.650E+02

1************************** 20**************************

INPUT DATA:

0.400 0.260 0.470 0.887 0.426

9.5 65.0 0 -2 1.800 0.930 0.930 0.960

FILE: CMB D A NAVAL POSTGRADUATE SCHOOL PAGE 001

1 SOLID FUEL RAMJET & TRAJECTORY

SUMMARY

AO/AR	A5/AR	TOB	XOB	YOB	TOF	X(MAX)	Y(MAX)	TETP	TETA
0.250E+00	0.250E+00	0.148E+02	0.235E+04	0.122E+05	0.323E+02	0.492E+04	0.227E+05	0.950E+01	0.800E+02
0.260E+00	0.250E+00	0.140E+02	0.224E+04	0.117E+05	0.324E+02	0.496E+04	0.229E+05	0.950E+01	0.800E+02
0.270E+00	0.250E+00	0.131E+02	0.211E+04	0.111E+05	0.323E+02	0.495E+04	0.229E+05	0.950E+01	0.800E+02
0.280E+00	0.250E+00	0.113E+02	0.135E+04	0.980E+04	0.314E+02	0.478E+04	0.223E+05	0.950E+01	0.800E+02
0.290E+00	0.250E+00	0.105E+02	0.172E+04	0.918E+04	0.314E+02	0.477E+04	0.222E+05	0.950E+01	0.800E+02
0.300E+00	0.250E+00	0.157E+02	0.225E+04	0.114E+05	0.166E+02	0.225E+04	0.114E+05	0.950E+01	0.800E+02
0.310E+00	0.250E+00	0.148E+02	0.213E+04	0.109E+05	0.157E+02	0.213E+04	0.109E+05	0.950E+01	0.800E+02
0.320E+00	0.250E+00	0.148E+02	0.214E+04	0.109E+05	0.157E+02	0.214E+04	0.109E+05	0.950E+01	0.800E+02
0.330E+00	0.250E+00	0.148E+02	0.214E+04	0.109E+05	0.157E+02	0.214E+04	0.109E+05	0.950E+01	0.800E+02
0.340E+00	0.250E+00	0.148E+02	0.214E+04	0.109E+05	0.157E+02	0.214E+04	0.109E+05	0.950E+01	0.800E+02
0.350E+00	0.250E+00	0.148E+02	0.214E+04	0.109E+05	0.157E+02	0.214E+04	0.109E+05	0.950E+01	0.800E+02
0.360E+00	0.250E+00	0.148E+02	0.214E+04	0.109E+05	0.157E+02	0.214E+04	0.109E+05	0.950E+01	0.800E+02
0.370E+00	0.250E+00	0.148E+02	0.214E+04	0.109E+05	0.157E+02	0.214E+04	0.109E+05	0.950E+01	0.800E+02
0.380E+00	0.250E+00	0.148E+02	0.214E+04	0.109E+05	0.157E+02	0.214E+04	0.109E+05	0.950E+01	0.800E+02
0.390E+00	0.250E+00	0.148E+02	0.214E+04	0.109E+05	0.157E+02	0.214E+04	0.109E+05	0.950E+01	0.800E+02
0.400E+00	0.250E+00	0.148E+02	0.214E+04	0.109E+05	0.157E+02	0.214E+04	0.109E+05	0.950E+01	0.800E+02
0.250E+00	0.260E+00	0.156E+02	0.245E+04	0.126E+05	0.329E+02	0.501E+04	0.230E+05	0.950E+01	0.800E+02
0.260E+00	0.260E+00	0.148E+02	0.234E+04	0.121E+05	0.330E+02	0.505E+04	0.232E+05	0.950E+01	0.800E+02
0.270E+00	0.260E+00	0.139E+02	0.222E+04	0.116E+05	0.329E+02	0.504E+04	0.232E+05	0.950E+01	0.800E+02
0.280E+00	0.260E+00	0.130E+02	0.209E+04	0.110E+05	0.329E+02	0.505E+04	0.233E+05	0.950E+01	0.800E+02
0.290E+00	0.260E+00	0.121E+02	0.177E+04	0.104E+05	0.329E+02	0.505E+04	0.233E+05	0.950E+01	0.800E+02
0.300E+00	0.260E+00	0.104E+02	0.171E+04	0.910E+04	0.312E+02	0.474E+04	0.221E+05	0.950E+01	0.800E+02
0.310E+00	0.260E+00	0.156E+02	0.222E+04	0.113E+05	0.165E+02	0.222E+04	0.113E+05	0.950E+01	0.800E+02
0.320E+00	0.260E+00	0.147E+02	0.210E+04	0.107E+05	0.156E+02	0.210E+04	0.107E+05	0.950E+01	0.800E+02
0.330E+00	0.260E+00	0.147E+02	0.211E+04	0.108E+05	0.156E+02	0.211E+04	0.108E+05	0.950E+01	0.800E+02
0.340E+00	0.260E+00	0.147E+02	0.211E+04	0.108E+05	0.156E+02	0.211E+04	0.104E+05	0.950E+01	0.800E+02
0.350E+00	0.260E+00	0.147E+02	0.211E+04	0.109E+05	0.156E+02	0.211E+04	0.108E+05	0.950E+01	0.800E+02
0.360E+00	0.260E+00	0.147E+02	0.211E+04	0.108E+05	0.156E+02	0.211E+04	0.108E+05	0.950E+01	0.800E+02
0.370E+00	0.260E+00	0.147E+02	0.211E+04	0.108E+05	0.156E+02	0.211E+04	0.108E+05	0.950E+01	0.800E+02
0.380E+00	0.260E+00	0.147E+02	0.211E+04	0.108E+05	0.156E+02	0.211E+04	0.108E+05	0.950E+01	0.800E+02
0.390E+00	0.260E+00	0.147E+02	0.211E+04	0.108E+05	0.156E+02	0.211E+04	0.108E+05	0.950E+01	0.800E+02
0.400E+00	0.260E+00	0.147E+02	0.211E+04	0.108E+05	0.156E+02	0.211E+04	0.108E+05	0.950E+01	0.800E+02

1+++++++++++++++++++++++++++ 20++++++++++++++++++++++++++

INPUT DATA:

0.400 0.260 0.470 0.887 0.426

9.5 80.0 0 -2 1.800 0.930 0.930 0.960

1 SOLID FUEL RAMJET & TRAJECTORY

SUMMARY

AO/AR	AS/AR	TOB	XOB	YOB	TOF	X(MAX)	Y(MAX)	TETP	TETA
0.250E+00	0.250E+00	0.202E+02	0.160E+05	-0.228E+01	0.203E+02	0.160E+05	-0.228E+01	0.950E+01	0.700E+01
0.260E+00	0.250E+00	0.205E+02	0.163E+05	-0.101E+02	0.206E+02	0.163E+05	-0.101E+02	0.950E+01	0.700E+01
0.270E+00	0.250E+00	0.204E+02	0.163E+05	-0.645E+01	0.205E+02	0.163E+05	-0.645E+01	0.950E+01	0.700E+01
0.280E+00	0.250E+00	0.193E+02	0.130E+05	0.507E+02	0.191E+02	0.130E+05	0.507E+02	0.950E+01	0.700E+01
0.290E+00	0.250E+00	0.175E+02	0.119E+05	0.153E+03	0.176E+02	0.119E+05	0.153E+03	0.950E+01	0.700E+01
0.300E+00	0.250E+00	0.173E+02	0.122E+05	0.138E+03	0.179E+02	0.122E+05	0.138E+03	0.950E+01	0.700E+01
0.310E+00	0.250E+00	0.178E+02	0.122E+05	0.138E+03	0.179E+02	0.122E+05	0.138E+03	0.950E+01	0.700E+01
0.320E+00	0.250E+00	0.178E+02	0.122E+05	0.138E+03	0.179E+02	0.122E+05	0.138E+03	0.950E+01	0.700E+01
0.330E+00	0.250E+00	0.178E+02	0.122E+05	0.138E+03	0.179E+02	0.122E+05	0.138E+03	0.950E+01	0.700E+01
0.340E+00	0.250E+00	0.178E+02	0.122E+05	0.138E+03	0.179E+02	0.122E+05	0.138E+03	0.950E+01	0.700E+01
0.350E+00	0.250E+00	0.178E+02	0.122E+05	0.138E+03	0.179E+02	0.122E+05	0.138E+03	0.950E+01	0.700E+01
0.360E+00	0.250E+00	0.178E+02	0.122E+05	0.138E+03	0.179E+02	0.122E+05	0.138E+03	0.950E+01	0.700E+01
0.370E+00	0.250E+00	0.178E+02	0.122E+05	0.138E+03	0.179E+02	0.122E+05	0.138E+03	0.950E+01	0.700E+01
0.380E+00	0.250E+00	0.178E+02	0.122E+05	0.138E+03	0.179E+02	0.122E+05	0.138E+03	0.950E+01	0.700E+01
0.390E+00	0.250E+00	0.178E+02	0.122E+05	0.138E+03	0.179E+02	0.122E+05	0.138E+03	0.950E+01	0.700E+01
0.400E+00	0.250E+00	0.178E+02	0.122E+05	0.138E+03	0.179E+02	0.122E+05	0.138E+03	0.950E+01	0.700E+01
0.250E+00	0.260E+00	0.200E+02	0.157E+05	-0.866E+00	0.202E+02	0.157E+05	-0.866E+00	0.950E+01	0.700E+01
0.260E+00	0.260E+00	0.203E+02	0.161E+05	-0.804E+01	0.204E+02	0.161E+05	-0.804E+01	0.950E+01	0.700E+01
0.270E+00	0.260E+00	0.203E+02	0.161E+05	-0.467E+01	0.204E+02	0.161E+05	-0.467E+01	0.950E+01	0.700E+01
0.280E+00	0.260E+00	0.204E+02	0.163E+05	-0.100E+02	0.205E+02	0.163E+05	-0.100E+02	0.950E+01	0.700E+01
0.290E+00	0.260E+00	0.188E+02	0.124E+05	0.606E+02	0.187E+02	0.124E+05	0.606E+02	0.950E+01	0.700E+01
0.300E+00	0.260E+00	0.172E+02	0.117E+05	0.160E+03	0.173E+02	0.117E+05	0.160E+03	0.950E+01	0.700E+01
0.310E+00	0.260E+00	0.175E+02	0.119E+05	0.153E+03	0.176E+02	0.119E+05	0.153E+03	0.950E+01	0.700E+01
0.320E+00	0.260E+00	0.175E+02	0.119E+05	0.153E+03	0.176E+02	0.119E+05	0.153E+03	0.950E+01	0.700E+01
0.330E+00	0.260E+00	0.175E+02	0.119E+05	0.153E+03	0.176E+02	0.119E+05	0.153E+03	0.950E+01	0.700E+01
0.340E+00	0.260E+00	0.175E+02	0.119E+05	0.153E+03	0.176E+02	0.119E+05	0.153E+03	0.950E+01	0.700E+01
0.350E+00	0.260E+00	0.175E+02	0.119E+05	0.153E+03	0.176E+02	0.119E+05	0.153E+03	0.950E+01	0.700E+01
0.360E+00	0.260E+00	0.175E+02	0.119E+05	0.153E+03	0.176E+02	0.119E+05	0.153E+03	0.950E+01	0.700E+01
0.370E+00	0.260E+00	0.175E+02	0.119E+05	0.153E+03	0.176E+02	0.119E+05	0.153E+03	0.950E+01	0.700E+01
0.380E+00	0.260E+00	0.175E+02	0.119E+05	0.153E+03	0.176E+02	0.119E+05	0.153E+03	0.950E+01	0.700E+01
0.390E+00	0.260E+00	0.175E+02	0.119E+05	0.153E+03	0.176E+02	0.119E+05	0.153E+03	0.950E+01	0.700E+01
0.400E+00	0.260E+00	0.175E+02	0.119E+05	0.153E+03	0.176E+02	0.119E+05	0.153E+03	0.950E+01	0.700E+01

```
1++++++++++++++++++++++++++ 20++++++++++++++++++++++++++++
 INPUT DATA:
   0.400     0.260     0.500     0.827     0.426
 9.5   7.0  0 -2 1.800 0.930 0.930 0.760
```

1   SOLID FUEL RAMJET & TRAJECTORY

SUMMARY

A0/AR	A5/AR	TOB	XOB	YOB	TOF	X(MAX)	Y(MAX)	TETP	TETA
0.250E+00	0.250E+00	0.442E+02	0.346E+05	0.613E+04	0.700E+02	0.510E+05	0.177E+04	0.950E+01	0.250E+02
0.260E+00	0.250E+00	0.440E+02	0.348E+05	0.633E+04	0.739E+02	0.538E+05	0.994E+03	0.950E+01	0.250E+02
0.270E+00	0.250E+00	0.431E+02	0.344E+05	0.646E+04	0.738E+02	0.540E+05	0.116E+04	0.950E+01	0.250E+02
0.280E+00	0.250E+00	0.191E+02	0.126E+05	0.420E+04	0.195E+02	0.126E+05	0.420E+04	0.950E+01	0.250E+02
0.290E+00	0.250E+00	0.171E+02	0.112E+05	0.389E+04	0.174E+02	0.112E+05	0.389E+04	0.950E+01	0.250E+02
0.300E+00	0.250E+00	0.176E+02	0.116E+05	0.399E+04	0.180E+02	0.116E+05	0.399E+04	0.950E+01	0.250E+02
0.310E+00	0.250E+00	0.176E+02	0.116E+05	0.399E+04	0.180E+02	0.116E+05	0.399E+04	0.950E+01	0.250E+02
0.320E+00	0.250E+00	0.176E+02	0.116E+05	0.399E+04	0.180E+02	0.116E+05	0.399E+04	0.950E+01	0.250E+02
0.330E+00	0.250E+00	0.176E+02	0.116E+05	0.399E+04	0.180E+02	0.116E+05	0.399E+04	0.950E+01	0.250E+02
0.340E+00	0.250E+00	0.176E+02	0.116E+05	0.399E+04	0.180E+02	0.116E+05	0.399E+04	0.950E+01	0.250E+02
0.350E+00	0.250E+00	0.176E+02	0.116E+05	0.399E+04	0.180E+02	0.116E+05	0.399E+04	0.950E+01	0.250E+02
0.360E+00	0.250E+00	0.176E+02	0.116E+05	0.399E+04	0.180E+02	0.116E+05	0.399E+04	0.950E+01	0.250E+02
0.370E+00	0.250E+00	0.176E+02	0.116E+05	0.399E+04	0.180E+02	0.116E+05	0.399E+04	0.950E+01	0.250E+02
0.380E+00	0.250E+00	0.176E+02	0.116E+05	0.399E+04	0.180E+02	0.116E+05	0.399E+04	0.950E+01	0.250E+02
0.390E+00	0.250E+00	0.176E+02	0.116E+05	0.399E+04	0.180E+02	0.116E+05	0.399E+04	0.950E+01	0.250E+02
0.400E+00	0.250E+00	0.176E+02	0.116E+05	0.399E+04	0.180E+02	0.116E+05	0.399E+04	0.950E+01	0.250E+02
0.250E+00	0.260E+00	0.439E+02	0.342E+05	0.635E+04	0.692E+02	0.502E+05	0.164E+04	0.950E+01	0.250E+02
0.260E+00	0.260E+00	0.436E+02	0.343E+05	0.625E+04	0.729E+02	0.529E+05	0.110E+04	0.950E+01	0.250E+02
0.270E+00	0.260E+00	0.431E+02	0.342E+05	0.636E+04	0.732E+02	0.534E+05	0.116E+04	0.950E+01	0.250E+02
0.280E+00	0.260E+00	0.424E+02	0.337E+05	0.652E+04	0.732E+02	0.534E+05	0.135E+04	0.950E+01	0.250E+02
0.290E+00	0.260E+00	0.190E+02	0.124E+05	0.415E+04	0.193E+02	0.124E+05	0.415E+04	0.950E+01	0.250E+02
0.300E+00	0.260E+00	0.169E+02	0.111E+05	0.384E+04	0.173E+02	0.111E+05	0.384E+04	0.950E+01	0.250E+02
0.310E+00	0.260E+00	0.171E+02	0.113E+05	0.390E+04	0.175E+02	0.113E+05	0.390E+04	0.950E+01	0.250E+02
0.320E+00	0.260E+00	0.171E+02	0.113E+05	0.390E+04	0.175E+02	0.113E+05	0.390E+04	0.950E+01	0.250E+02
0.330E+00	0.260E+00	0.171E+02	0.113E+05	0.390E+04	0.175E+02	0.113E+05	0.390E+04	0.950E+01	0.250E+02
0.340E+00	0.260E+00	0.171E+02	0.113E+05	0.390E+04	0.175E+02	0.113E+05	0.390E+04	0.950E+01	0.250E+02
0.350E+00	0.260E+00	0.171E+02	0.113E+05	0.390E+04	0.175E+02	0.113E+05	0.390E+04	0.950E+01	0.250E+02
0.360E+00	0.260E+00	0.171E+02	0.113E+05	0.390E+04	0.175E+02	0.113E+05	0.390E+04	0.950E+01	0.250E+02
0.370E+00	0.260E+00	0.171E+02	0.113E+05	0.390E+04	0.175E+02	0.113E+05	0.390E+04	0.950E+01	0.250E+02
0.380E+00	0.260E+00	0.171E+02	0.113E+05	0.390E+04	0.175E+02	0.113E+05	0.390E+04	0.950E+01	0.250E+02
0.390E+00	0.260E+00	0.171E+02	0.113E+05	0.390E+04	0.175E+02	0.113E+05	0.390E+04	0.950E+01	0.250E+02
0.400E+00	0.260E+00	0.171E+02	0.113E+05	0.390E+04	0.175E+02	0.113E+05	0.390E+04	0.950E+01	0.250E+02

1++++++++++++++++++++++++++ 20+++++++++++++++++++++++++++

INPUT DATA:

C.400   0.260   0.500   0.827   0.426

9.5 25.0 0 -2 1.800 0.930 0.930 0.960

FILE: CMR D A NAVAL POSTGRADUATE SCHOOL PAGE 001

1 SOLID FUEL RAMJET & TRAJECTORY

SUMMARY

AO/AR	A5/AR	TOB	XOB	YOB	TOF	X(MAX)	Y(MAX)	TETP	TETA
0.250E+00	0.250E+00	0.175E+02	0.103E+05	0.935E+04	0.476E+02	0.278E+05	0.171E+05	0.950E+01	0.450E+02
0.260E+00	0.250E+00	0.157E+02	0.920E+04	0.862E+04	0.459E+02	0.267E+05	0.168E+05	0.950E+01	0.450E+02
0.270E+00	0.250E+00	0.132E+02	0.834E+04	0.744E+04	0.407E+02	0.235E+05	0.158E+05	0.950E+01	0.450E+02
0.280E+00	0.250E+00	0.175E+02	0.955E+04	0.404E+04	0.182E+02	0.956E+04	0.804E+04	0.950E+01	0.450E+02
0.290E+00	0.250E+00	0.169E+02	0.918E+04	0.777E+04	0.175E+02	0.919E+04	0.777E+04	0.950E+01	0.450E+02
0.300E+00	0.250E+00	0.169E+02	0.924E+04	0.792E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.310E+00	0.250E+00	0.169E+02	0.924E+04	0.782E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.320E+00	0.250E+00	0.169E+02	0.924E+04	0.782E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.330E+00	0.250E+00	0.169E+02	0.924E+04	0.782E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.340E+00	0.250E+00	0.169E+02	0.924E+04	0.782E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.350E+00	0.250E+00	0.169E+02	0.924E+04	0.782E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.360E+00	0.250E+00	0.169E+02	0.924E+04	0.782E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.370E+00	0.250E+00	0.169E+02	0.924E+04	0.782E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.380E+00	0.250E+00	0.169E+02	0.924E+04	0.782E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.390E+00	0.250E+00	0.169E+02	0.924E+04	0.782E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.400E+00	0.250E+00	0.159E+02	0.924E+04	0.792E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.250E+00	0.260E+00	0.218E+02	0.135E+05	0.111E+05	0.585E+02	0.345E+05	0.182E+05	0.950E+01	0.450E+02
0.260E+00	0.260E+00	0.194E+02	0.121E+05	0.132E+05	0.556E+02	0.327E+05	0.181E+05	0.950E+01	0.450E+02
0.270E+00	0.260E+00	0.174E+02	0.110E+05	0.938E+04	0.515E+02	0.303E+05	0.178E+05	0.950E+01	0.450E+02
0.280E+00	0.260E+00	0.143E+02	0.995E+04	0.799E+04	0.442E+02	0.257E+05	0.166E+05	0.950E+01	0.450E+02
0.290E+00	0.260E+00	0.168E+02	0.915E+04	0.776E+04	0.174E+02	0.914E+04	0.776E+04	0.950E+01	0.450E+02
0.300E+00	0.260E+00	0.161E+02	0.878E+04	0.749E+04	0.167E+02	0.878E+04	0.749E+04	0.950E+01	0.450E+02
0.310E+00	0.260E+00	0.162E+02	0.884E+04	0.754E+04	0.168E+02	0.884E+04	0.754E+04	0.950E+01	0.450E+02
0.320E+00	0.260E+00	0.162E+02	0.884E+04	0.754E+04	0.168E+02	0.884E+04	0.754E+04	0.950E+01	0.450E+02
0.330E+00	0.260E+00	0.162E+02	0.884E+04	0.754E+04	0.168E+02	0.884E+04	0.754E+04	0.950E+01	0.450E+02
0.340E+00	0.260E+00	0.162E+02	0.884E+04	0.754E+04	0.168E+02	0.884E+04	0.754E+04	0.950E+01	0.450E+02
0.350E+00	0.260E+00	0.162E+02	0.884E+04	0.754E+04	0.168E+02	0.884E+04	0.754E+04	0.950E+01	0.450E+02
0.360E+00	0.260E+00	0.162E+02	0.884E+04	0.754E+04	0.168E+02	0.884E+04	0.754E+04	0.950E+01	0.450E+02
0.370E+00	0.260E+00	0.162E+02	0.884E+04	0.754E+04	0.168E+02	0.884E+04	0.754E+04	0.950E+01	0.450E+02
0.380E+00	0.260E+00	0.162E+02	0.884E+04	0.754E+04	0.168E+02	0.884E+04	0.754E+04	0.950E+01	0.450E+02
0.390E+00	0.260E+00	0.162E+02	0.884E+04	0.754E+04	0.168E+02	0.884E+04	0.754E+04	0.950E+01	0.450E+02
0.400E+00	0.260E+00	0.162E+02	0.884E+04	0.754E+04	0.168E+02	0.884E+04	0.754E+04	0.950E+01	0.450E+02

1+++++++++++++++++++++++++++ 20++++++++++++++++++++++++++++

INPUT DATA:

0.400 0.260 0.500 0.377 0.426

9.5 45.0 0 -2 1.800 0.930 0.930 0.960

1 SOLID FUEL RAMJET & TRAJECTORY

SUMMARY

AO/AR	A5/AR	TOB	XOB	YOB	TOF	X(MAX)	Y(MAX)	TETP	TETA
0.250E+00	0.250E+00	0.120E+02	0.464E+04	0.918E+04	0.313E+02	0.112E+05	0.193E+05	0.950E+01	0.650E+02
0.260E+00	0.250E+00	0.113E+02	0.439E+04	0.874E+04	0.314E+02	0.113E+05	0.195E+05	0.950E+01	0.650E+02
0.270E+00	0.250E+00	0.964E+01	0.380E+04	0.765E+04	0.297E+02	0.106E+05	0.185E+05	0.950E+01	0.650E+02
0.280E+00	0.250E+00	0.161E+02	0.550E+04	0.104E+05	0.169E+02	0.550E+04	0.104E+05	0.950E+01	0.650E+02
0.290E+00	0.250E+00	0.152E+02	0.523E+04	0.999E+04	0.160E+02	0.523E+04	0.999E+04	0.950E+01	0.650E+02
0.300E+00	0.250E+00	0.161E+02	0.548E+04	0.104E+05	0.169E+02	0.548E+04	0.104E+05	0.950E+01	0.650E+02
0.310E+00	0.250E+00	0.161E+02	0.548E+04	0.104E+05	0.169E+02	0.548E+04	0.104E+05	0.950E+01	0.650E+02
0.320E+00	0.250E+00	0.161E+02	0.548E+04	0.104E+05	0.169E+02	0.548E+04	0.104E+05	0.950E+01	0.650E+02
0.330E+00	0.250E+00	0.161E+02	0.548E+04	0.104E+05	0.169E+02	0.548E+04	0.104E+05	0.950E+01	0.650E+02
0.340E+00	0.250E+00	0.161E+02	0.548E+04	0.104E+05	0.169E+02	0.548E+04	0.104E+05	0.950E+01	0.650E+02
0.350E+00	0.250E+00	0.161E+02	0.548E+04	0.104E+05	0.169E+02	0.548E+04	0.104E+05	0.950E+01	0.650E+02
0.360E+00	0.250E+00	0.161E+02	0.548E+04	0.104E+05	0.169E+02	0.548E+04	0.104E+05	0.950E+01	0.650E+02
0.370E+00	0.250E+00	0.161E+02	0.548E+04	0.104E+05	0.169E+02	0.548E+04	0.104E+05	0.950E+01	0.650E+02
0.380E+00	0.250E+00	0.161E+02	0.548E+04	0.104E+05	0.169E+02	0.548E+04	0.104E+05	0.950E+01	0.650E+02
0.390E+00	0.250E+00	0.161E+02	0.548E+04	0.104E+05	0.169E+02	0.548E+04	0.104E+05	0.950E+01	0.650E+02
0.400E+00	0.250E+00	0.161E+02	0.548E+04	0.104E+05	0.169E+02	0.548E+04	0.104E+05	0.950E+01	0.650E+02
0.250E+00	0.260E+00	0.136E+02	0.516E+04	0.101E+05	0.327E+02	0.119E+05	0.200E+05	0.950E+01	0.650E+02
0.260E+00	0.260E+00	0.128E+02	0.492E+04	0.959E+04	0.324E+02	0.119E+05	0.202E+05	0.950E+01	0.650E+02
0.270E+00	0.260E+00	0.112E+02	0.433E+04	0.863E+04	0.319E+02	0.114E+05	0.196E+05	0.950E+01	0.650E+02
0.280E+00	0.260E+00	0.957E+01	0.376E+04	0.758E+04	0.303E+02	0.109E+05	0.187E+05	0.950E+01	0.650E+02
0.290E+00	0.260E+00	0.159E+02	0.542E+04	0.103E+05	0.167E+02	0.542E+04	0.103E+05	0.950E+01	0.650E+02
0.300E+00	0.260E+00	0.151E+02	0.516E+04	0.986E+04	0.159E+02	0.516E+04	0.986E+04	0.950E+01	0.650E+02
0.310E+00	0.260E+00	0.151E+02	0.519E+04	0.991E+04	0.159E+02	0.519E+04	0.991E+04	0.950E+01	0.650E+02
0.320E+00	0.260E+00	0.151E+02	0.519E+04	0.991E+04	0.159E+02	0.519E+04	0.991E+04	0.950E+01	0.650E+02
0.330E+00	0.260E+00	0.151E+02	0.519E+04	0.991E+04	0.159E+02	0.519E+04	0.991E+04	0.950E+01	0.650E+02
0.340E+00	0.260E+00	0.151E+02	0.519E+04	0.991E+04	0.159E+02	0.519E+04	0.991E+04	0.950E+01	0.650E+02
0.350E+00	0.260E+00	0.151E+02	0.519E+04	0.991E+04	0.159E+02	0.519E+04	0.991E+04	0.950E+01	0.650E+02
0.360E+00	0.260E+00	0.151E+02	0.519E+04	0.991E+04	0.159E+02	0.519E+04	0.991E+04	0.950E+01	0.650E+02
0.370E+00	0.260E+00	0.151E+02	0.519E+04	0.991E+04	0.159E+02	0.519E+04	0.991E+04	0.950E+01	0.650E+02
0.380E+00	0.260E+00	0.151E+02	0.519E+04	0.991E+04	0.159E+02	0.519E+04	0.991E+04	0.950E+01	0.650E+02
0.390E+00	0.260E+00	0.151E+02	0.519E+04	0.991E+04	0.159E+02	0.519E+04	0.991E+04	0.950E+01	0.650E+02
0.400E+00	0.260E+00	0.151E+02	0.519E+04	0.991E+04	0.159E+02	0.519E+04	0.991E+04	0.950E+01	0.650E+02

```
1+++++++++++++++++++++++++ 20++++++++++++++++++++++++++
  INPUT DATA:
    0.400      0.260      0.500      0.827      0.426
  4.5  65.0  0 -2 1.800 0.930 0.930 0.960
```

1 SOLID FUEL RAMJET & TRAJECTORY

SUMMARY

AO/AR	A5/AR	TOB	XOB	YOB	TOF	X(MAX)	Y(MAX)	TETP	TETA
0.250E+00	0.250E+00	0.113E+02	0.182E+04	0.962E+04	0.288E+02	0.430E+04	0.203E+05	0.950E+01	0.800E+02
0.260E+00	0.250E+00	0.105E+02	0.170E+04	0.907E+04	0.289E+02	0.432E+04	0.204E+05	0.950E+01	0.800E+02
0.270E+00	0.250E+00	0.873E+01	0.144E+04	0.774E+04	0.271E+02	0.401E+04	0.192E+05	0.950E+01	0.800E+02
0.280E+00	0.250E+00	0.157E+02	0.225E+04	0.114E+05	0.166E+02	0.225E+04	0.114E+05	0.950E+01	0.800E+02
0.290E+00	0.250E+00	0.148E+02	0.213E+04	0.109E+05	0.157E+02	0.213E+04	0.109E+05	0.950E+01	0.800E+02
0.300E+00	0.250E+00	0.148E+02	0.214E+04	0.109E+05	0.157E+02	0.214E+04	0.109E+05	0.950E+01	0.800E+02
0.310E+00	0.250E+00	0.148E+02	0.214E+04	0.109E+05	0.157E+02	0.214E+04	0.109E+05	0.950E+01	0.800E+02
0.320E+00	0.250E+00	0.148E+02	0.214E+04	0.109E+05	0.157E+02	0.214E+04	0.109E+05	0.950E+01	0.800E+02
0.330E+00	0.250E+00	0.148E+02	0.214E+04	0.109E+05	0.157E+02	0.214E+04	0.109E+05	0.950E+01	0.800E+02
0.340E+00	0.250E+00	0.149E+02	0.214E+04	0.109E+05	0.157E+02	0.214E+04	0.109E+05	0.950E+01	0.800E+02
0.350E+00	0.250E+00	0.148E+02	0.214E+04	0.109E+05	0.157E+02	0.214E+04	0.109E+05	0.950E+01	0.800E+02
0.360E+00	0.250E+00	0.148E+02	0.214E+04	0.109E+05	0.157E+02	0.214E+04	0.109E+05	0.950E+01	0.800E+02
0.370E+00	0.250E+00	0.148E+02	0.214E+04	0.109E+05	0.157E+02	0.214E+04	0.109E+05	0.950E+01	0.800E+02
0.380E+00	0.250E+00	0.148E+02	0.214E+04	0.109E+05	0.157E+02	0.214E+04	0.109E+05	0.950E+01	0.800E+02
0.390E+00	0.250E+00	0.148E+02	0.214E+04	0.109E+05	0.157E+02	0.214E+04	0.109E+05	0.950E+01	0.800E+02
0.400E+00	0.250E+00	0.148E+02	0.214E+04	0.109E+05	0.157E+02	0.214E+04	0.109E+05	0.950E+01	0.800E+02
0.250E+00	0.260E+00	0.121E+02	0.192E+04	0.101E+05	0.295E+02	0.437E+04	0.206E+05	0.950E+01	0.800E+02
0.260E+00	0.260E+00	0.113E+02	0.181E+04	0.959E+04	0.295E+02	0.442E+04	0.208E+05	0.950E+01	0.800E+02
0.270E+00	0.260E+00	0.104E+02	0.168E+04	0.896E+04	0.295E+02	0.439E+04	0.207E+05	0.950E+01	0.800E+02
0.280E+00	0.260E+00	0.953E+01	0.156E+04	0.834E+04	0.286E+02	0.426E+04	0.202E+05	0.950E+01	0.800E+02
0.290E+00	0.260E+00	0.156E+02	0.222E+04	0.113E+05	0.165E+02	0.222E+04	0.113E+05	0.950E+01	0.800E+02
0.300E+00	0.260E+00	0.147E+02	0.210E+04	0.107E+05	0.156E+02	0.210E+04	0.107E+05	0.950E+01	0.800E+02
0.310E+00	0.260E+00	0.147E+02	0.211E+04	0.108E+05	0.156E+02	0.211E+04	0.108E+05	0.950E+01	0.800E+02
0.320E+00	0.260E+00	0.147E+02	0.211E+04	0.108E+05	0.156E+02	0.211E+04	0.108E+05	0.950E+01	0.800E+02
0.330E+00	0.260E+00	0.147E+02	0.211E+04	0.108E+05	0.156E+02	0.211E+04	0.108E+05	0.950E+01	0.800E+02
0.340E+00	0.260E+00	0.147E+02	0.211E+04	0.108E+05	0.156E+02	0.211E+04	0.109E+05	0.950E+01	0.800E+02
0.350E+00	0.260E+00	0.147E+02	0.211E+04	0.108E+05	0.156E+02	0.211E+04	0.108E+05	0.950E+01	0.800E+02
0.360E+00	0.260E+00	0.147E+02	0.211E+04	0.108E+05	0.155E+02	0.211E+04	0.108E+05	0.950E+01	0.800E+02
0.370E+00	0.260E+00	0.147E+02	0.211E+04	0.108E+05	0.156E+02	0.211E+04	0.108E+05	0.950E+01	0.800E+02
0.380E+00	0.260E+00	0.147E+02	0.211E+04	0.108E+05	0.156E+02	0.211E+04	0.108E+05	0.950E+01	0.800E+02
0.390E+00	0.260E+00	0.147E+02	0.211E+04	0.108E+05	0.156E+02	0.211E+04	0.108E+05	0.950E+01	0.800E+02
0.400E+00	0.260E+00	0.147E+02	0.211E+04	0.108E+05	0.156E+02	0.211E+04	0.109E+05	0.950E+01	0.800E+02

1++++++++++++++++++++++++++ 20++++++++++++++++++++++++++++

INPUT DATA:

```
  0.400     0.260     0.500     0.827     0.426
9.5  80.0  0 -2 1.800 0.930 0.930 0.960
```

1 SOLID FUEL RAMJET & TRAJECTORY

SUMMARY

AO/AR	A5/AR	TOB	XOB	YOB	TOF	X(MAX)	Y(MAX)	TETP	TETA
0.250E+00	0.250E+00	0.351E+02	0.222E+05	0.158E+05	0.132E+03	0.751E+05	-0.295E+02	0.950E+01	0.450E+02
0.260E+00	0.250E+00	0.346E+02	0.222E+05	0.159E+05	0.133E+03	0.772E+05	-0.774E+02	0.950E+01	0.450E+02
0.270E+00	0.250E+00	0.345E+02	0.223E+05	0.160E+05	0.135E+03	0.788E+05	-0.544E+02	0.950E+01	0.450E+02
0.280E+00	0.250E+00	0.345E+02	0.225E+05	0.162E+05	0.136E+03	0.806E+05	-0.743E+01	0.950E+01	0.450E+02
0.290E+00	0.250E+00	0.338E+02	0.222E+05	0.162E+05	0.137E+03	0.821E+05	-0.917E+02	0.950E+01	0.450E+02
0.300E+00	0.250E+00	0.326E+02	0.216E+05	0.159E+05	0.138E+03	0.830E+05	-0.176E+02	0.950E+01	0.450E+02
0.310E+00	0.250E+00	0.320E+02	0.213E+05	0.159E+05	0.139E+03	0.843E+05	-0.176E+03	0.950E+01	0.450E+02
0.320E+00	0.250E+00	0.301E+02	0.201E+05	0.153E+05	0.135E+03	0.844E+05	-0.303E+02	0.950E+01	0.450E+02
0.330E+00	0.250E+00	0.175E+02	0.958E+04	0.806E+04	0.182E+02	0.958E+04	0.806E+04	0.950E+01	0.450E+02
0.340E+00	0.250E+00	0.168E+02	0.916E+04	0.775E+04	0.175E+02	0.916E+04	0.775E+04	0.950E+01	0.450E+02
0.350E+00	0.250E+00	0.169E+02	0.924E+04	0.782E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.360E+00	0.250E+00	0.169E+02	0.924E+04	0.782E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.370E+00	0.250E+00	0.169E+02	0.924E+04	0.782E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.380E+00	0.250E+00	0.169E+02	0.924E+04	0.782E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.390E+00	0.250E+00	0.169E+02	0.924E+04	0.782E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.400E+00	0.250E+00	0.169E+02	0.924E+04	0.782E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.250E+00	0.260E+00	0.373E+02	0.236E+05	0.163E+05	0.133E+03	0.755E+05	-0.213E+03	0.950E+01	0.450E+02
0.260E+00	0.260E+00	0.369E+02	0.236E+05	0.164E+05	0.134E+03	0.774E+05	-0.239E+03	0.950E+01	0.450E+02
0.270E+00	0.260E+00	0.373E+02	0.241E+05	0.168E+05	0.135E+03	0.795E+05	-0.121E+03	0.950E+01	0.450E+02
0.280E+00	0.260E+00	0.373E+02	0.243E+05	0.170E+05	0.136E+03	0.814E+05	-0.648E+02	0.950E+01	0.450E+02
0.290E+00	0.260E+00	0.373E+02	0.246E+05	0.172E+05	0.137E+03	0.833E+05	-0.284E+02	0.950E+01	0.450E+02
0.300E+00	0.260E+00	0.367E+02	0.243E+05	0.172E+05	0.139E+03	0.848E+05	-0.975E+02	0.950E+01	0.450E+02
0.310E+00	0.260E+00	0.361E+02	0.241E+05	0.172E+05	0.140E+03	0.862E+05	-0.204E+03	0.950E+01	0.450E+02
0.320E+00	0.260E+00	0.348E+02	0.234E+05	0.169E+05	0.141E+03	0.873E+05	-0.138E+03	0.950E+01	0.450E+02
0.330E+00	0.260E+00	0.168E+02	0.918E+04	0.777E+04	0.174E+02	0.918E+04	0.777E+04	0.950E+01	0.450E+02
0.340E+00	0.260E+00	0.161E+02	0.877E+04	0.748E+04	0.167E+02	0.877E+04	0.748E+04	0.950E+01	0.450E+02
0.350E+00	0.260E+00	0.162E+02	0.884E+04	0.754E+04	0.168E+02	0.884E+04	0.754E+04	0.950E+01	0.450E+02
0.360E+00	0.260E+00	0.162E+02	0.884E+04	0.754E+04	0.168E+02	0.884E+04	0.754E+04	0.950E+01	0.450E+02
0.370E+00	0.260E+00	0.162E+02	0.884E+04	0.754E+04	0.168E+02	0.884E+04	0.754E+04	0.950E+01	0.450E+02
0.380E+00	0.260E+00	0.162E+02	0.884E+04	0.754E+04	0.168E+02	0.884E+04	0.754E+04	0.950E+01	0.450E+02
0.390E+00	0.260E+00	0.162E+02	0.884E+04	0.754E+04	0.168E+02	0.884E+04	0.754E+04	0.950E+01	0.450E+02
0.400E+00	0.260E+00	0.162E+02	0.884E+04	0.754E+04	0.168E+02	0.884E+04	0.754E+04	0.950E+01	0.450E+02

1++++++++++++++++++++++++++ 20++++++++++++++++++++++++++

INPUT DATA:

0.400 0.260 0.420 0.827 0.426

9.5 45.0 0 -2 1.800 0.930 0.930 0.960

1 SOLID FUEL RAMJET & TRAJECTORY

SUMMARY

AO/AR	AS/AR	TOB	XOB	YOB	TOF	X(MAX)	Y(MAX)	TETP	TETA
0.250E+00	0.250E+00	0.169E+02	0.924E+04	0.782E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.260E+00	0.250E+00	0.169E+02	0.924E+04	0.782E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.270E+00	0.250E+00	0.169E+02	0.924E+04	0.782E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.280E+00	0.250E+00	0.169E+02	0.924E+04	0.782E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.290E+00	0.250E+00	0.169E+02	0.924E+04	0.782E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.300E+00	0.250E+00	0.169E+02	0.924E+04	0.782E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.310E+00	0.250E+00	0.169E+02	0.924E+04	0.782E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.320E+00	0.250E+00	0.169E+02	0.924E+04	0.782E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.330E+00	0.250E+00	0.169E+02	0.924E+04	0.782E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.340E+00	0.250E+00	0.169E+02	0.924E+04	0.782E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.350E+00	0.250E+00	0.169E+02	0.924E+04	0.782E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.360E+00	0.250E+00	0.169E+02	0.924E+04	0.782E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.370E+00	0.250E+00	0.169E+02	0.924E+04	0.782E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.380E+00	0.250E+00	0.169E+02	0.924E+04	0.782E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.390E+00	0.250E+00	0.169E+02	0.924E+04	0.782E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.400E+00	0.250E+00	0.169E+02	0.924E+04	0.782E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.250E+00	0.260E+00	0.162E+02	0.884E+04	0.754E+04	0.168E+02	0.884E+04	0.754E+04	0.950E+01	0.450E+02
0.260E+00	0.260E+00	0.162E+02	0.884E+04	0.754E+04	0.169E+02	0.884E+04	0.754E+04	0.950E+01	0.450E+02
0.270E+00	0.260E+00	0.162E+02	0.884E+04	0.754E+04	0.168E+02	0.884E+04	0.754E+04	0.950E+01	0.450E+02
0.280E+00	0.260E+00	0.162E+02	0.884E+04	0.754E+04	0.168E+02	0.884E+04	0.754E+04	0.950E+01	0.450E+02
0.290E+00	0.260E+00	0.162E+02	0.884E+04	0.754E+04	0.168E+02	0.884E+04	0.754E+04	0.950E+01	0.450E+02
0.300E+00	0.260E+00	0.162E+02	0.884E+04	0.754E+04	0.168E+02	0.884E+04	0.754E+04	0.950E+01	0.450E+02
0.310E+00	0.260E+00	0.162E+02	0.884E+04	0.754E+04	0.168E+02	0.884E+04	0.754E+04	0.950E+01	0.450E+02
0.320E+00	0.260E+00	0.162E+02	0.884E+04	0.754E+04	0.168E+02	0.884E+04	0.754E+04	0.950E+01	0.450E+02
0.330E+00	0.260E+00	0.162E+02	0.884E+04	0.754E+04	0.168E+02	0.884E+04	0.754E+04	0.950E+01	0.450E+02
0.340E+00	0.260E+00	0.162E+02	0.884E+04	0.754E+04	0.168E+02	0.884E+04	0.754E+04	0.950E+01	0.450E+02
0.350E+00	0.260E+00	0.162E+02	0.884E+04	0.754E+04	0.169E+02	0.884E+04	0.754E+04	0.950E+01	0.450E+02
0.360E+00	0.260E+00	0.162E+02	0.884E+04	0.754E+04	0.168E+02	0.884E+04	0.754E+04	0.950E+01	0.450E+02
0.370E+00	0.260E+00	0.162E+02	0.884E+04	0.754E+04	0.168E+02	0.884E+04	0.754E+04	0.950E+01	0.450E+02
0.380E+00	0.260E+00	0.162E+02	0.884E+04	0.754E+04	0.168E+02	0.884E+04	0.754E+04	0.950E+01	0.450E+02
0.390E+00	0.260E+00	0.162E+02	0.884E+04	0.754E+04	0.168E+02	0.884E+04	0.754E+04	0.950E+01	0.450E+02
0.400E+00	0.260E+00	0.162E+02	0.884E+04	0.754E+04	0.168E+02	0.884E+04	0.754E+04	0.950E+01	0.450E+02

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INPUT DATA:

0.400 0.260 0.590 0.927 0.426

9.5 45.0 0 -2 1.800 0.930 0.930 0.960

FILE: CMB   D   A   NAVAL POSTGRADUATE SCHOOL   PAGE 001

1   SOLID FUEL RAMJET & TRAJECTORY

SUMMARY

AO/AR	A5/AR	TOB	XOB	YOB	TOF	X(MAX)	Y(MAX)	TETP	TETA
0.250E+00	0.250E+00	0.232E+02	0.145E+05	0.117E+05	0.127E+03	0.664E+05	0.276E+02	0.950E+01	0.450E+02
0.260E+00	0.250E+00	0.214E+02	0.135E+05	0.111E+05	0.127E+03	0.666E+05	-0.225E+03	0.950E+01	0.450E+02
0.270E+00	0.250E+00	0.194E+02	0.123E+05	0.103E+05	0.627E+02	0.371E+05	0.186E+05	0.950E+01	0.450E+02
0.280E+00	0.250E+00	0.175E+02	0.112E+05	0.958E+04	0.570E+02	0.338E+05	0.185E+05	0.950E+01	0.450E+02
0.290E+00	0.250E+00	0.175E+02	0.957E+04	0.805E+04	0.182E+02	0.957E+04	0.805E+04	0.950E+01	0.450E+02
0.300E+00	0.250E+00	0.168E+02	0.917E+04	0.776E+04	0.175E+02	0.917E+04	0.776E+04	0.950E+01	0.450E+02
0.310E+00	0.250E+00	0.169E+02	0.924E+04	0.782E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.320E+00	0.250E+00	0.169E+02	0.924E+04	0.782E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.330E+00	0.250E+00	0.169E+02	0.924E+04	0.782E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.340E+00	0.250E+00	0.169E+02	0.924E+04	0.782E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.350E+00	0.250E+00	0.169E+02	0.924E+04	0.782E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.360E+00	0.250E+00	0.169E+02	0.924E+04	0.782E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.370E+00	0.250E+00	0.169E+02	0.924E+04	0.782E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.380E+00	0.250E+00	0.169E+02	0.924E+04	0.782E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.390E+00	0.250E+00	0.169E+02	0.924E+04	0.782E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.400E+00	0.250E+00	0.169E+02	0.924E+04	0.782E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.250E+00	0.260E+00	0.261E+02	0.163E+05	0.127E+05	0.128E+03	0.683E+05	-0.177E+03	0.950E+01	0.450E+02
0.260E+00	0.260E+00	0.250E+02	0.157E+05	0.125E+05	0.129E+03	0.694E+05	-0.129E+03	0.950E+01	0.450E+02
0.270E+00	0.260E+00	0.243E+02	0.154E+05	0.123E+05	0.129E+03	0.703E+05	-0.722E+02	0.950E+01	0.450E+02
0.280E+00	0.260E+00	0.224E+02	0.143E+05	0.116E+05	0.129E+03	0.699E+05	-0.117E+03	0.950E+01	0.450E+02
0.290E+00	0.260E+00	0.199E+02	0.127E+05	0.107E+05	0.123E+03	0.682E+05	-0.840E+01	0.950E+01	0.450E+02
0.300E+00	0.260E+00	0.168E+02	0.917E+04	0.777E+04	0.174E+02	0.917E+04	0.777E+04	0.950E+01	0.450E+02
0.310E+00	0.260E+00	0.161E+02	0.879E+04	0.748E+04	0.167E+02	0.879E+04	0.748E+04	0.950E+01	0.450E+02
0.320E+00	0.260E+00	0.162E+02	0.884E+04	0.754E+04	0.168E+02	0.884E+04	0.754E+04	0.950E+01	0.450E+02
0.330E+00	0.260E+00	0.162E+02	0.994E+04	0.754E+04	0.169E+02	0.884E+04	0.754E+04	0.950E+01	0.450E+02
0.340E+00	0.260E+00	0.162E+02	0.894E+04	0.754E+04	0.168E+02	0.884E+04	0.754E+04	0.950E+01	0.450E+02
0.350E+00	0.260E+00	0.162E+02	0.884E+04	0.754E+04	0.168E+02	0.884E+04	0.754E+04	0.950E+01	0.450E+02
0.360E+00	0.260E+00	0.162E+02	0.884E+04	0.754E+04	0.168E+02	0.884E+04	0.754E+04	0.950E+01	0.450E+02
0.370E+00	0.260E+00	0.162E+02	0.884E+04	0.754E+04	0.168E+02	0.884E+04	0.754E+04	0.950E+01	0.450E+02
0.380E+00	0.260E+00	0.162E+02	0.884E+04	0.754E+04	0.158E+02	0.884E+04	0.754E+04	0.950E+01	0.450E+02
0.390E+00	0.260E+00	0.162E+02	0.884E+04	0.754E+04	0.168E+02	0.884E+04	0.754E+04	0.950E+01	0.450E+02
0.400E+00	0.260E+00	0.162E+02	0.884E+04	0.754E+04	0.168E+02	0.884E+04	0.754E+04	0.950E+01	0.450E+02

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INPUT DATA:

C.400   0.260   0.470   0.750   0.426

9.5 45.0 0 -2 1.000 0.930 0.930 0.960

1 SOLID FUEL RAMJET & TRAJECTORY

SUMMARY

AO/AR	A5/AR	TOR	XOR	YO3	TOF	X(MAX)	Y(MAX)	TETP	TETA
0.250E+00	0.250E+00	0.257E+02	0.161E+05	0.127E+05	0.128E+03	0.687E+05	-0.103E+03	0.950E+01	0.450E+02
0.260E+00	0.250E+00	0.239E+02	0.151E+05	0.122E+05	0.129E+03	0.693E+05	-0.268E+03	0.950E+01	0.450E+02
0.270E+00	0.250E+00	0.226E+02	0.143E+05	0.117E+05	0.129E+03	0.694E+05	-0.159E+03	0.950E+01	0.450E+02
0.280E+00	0.250E+00	0.201E+02	0.128E+05	0.107E+05	0.128E+03	0.679E+05	0.719E+01	0.950E+01	0.450E+02
0.290E+00	0.250E+00	0.175E+02	0.112E+05	0.964E+04	0.608E+02	0.361E+05	0.188E+05	0.950E+01	0.450E+02
0.300E+00	0.250E+00	0.175E+02	0.957E+04	0.805E+04	0.142E+02	0.957E+04	0.805E+04	0.950E+01	0.450E+02
0.310E+00	0.250E+00	0.168E+02	0.917E+04	0.776E+04	0.175E+02	0.917E+04	0.776E+04	0.950E+01	0.450E+02
0.320E+00	0.250E+00	0.169E+02	0.924E+04	0.782E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.330E+00	0.250E+00	0.169E+02	0.924E+04	0.782E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.340E+00	0.250E+00	0.169E+02	0.924E+04	0.782E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.350E+00	0.250E+00	0.169E+02	0.924E+04	0.782E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.360E+00	0.250E+00	0.169E+02	0.924E+04	0.782E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.370E+00	0.250E+00	0.169E+02	0.924E+04	0.782E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.380E+00	0.250E+00	0.169E+02	0.924E+04	0.782E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.390E+00	0.250E+00	0.169E+02	0.924E+04	0.782E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.400E+00	0.250E+00	0.169E+02	0.924E+04	0.782E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.250E+00	0.260E+00	0.292E+02	0.193E+05	0.139E+05	0.129E+03	0.705E+05	-0.395E+02	0.950E+01	0.450E+02
0.260E+00	0.260E+00	0.275E+02	0.173E+05	0.134E+05	0.130E+03	0.714E+05	-0.772E+02	0.950E+01	0.450E+02
0.270E+00	0.260E+00	0.263E+02	0.170E+05	0.133E+05	0.131E+03	0.727E+05	-0.239E+03	0.950E+01	0.450E+02
0.280E+00	0.260E+00	0.249E+02	0.159E+05	0.127E+05	0.131E+03	0.726E+05	-0.161E+03	0.950E+01	0.450E+02
0.290E+00	0.260E+00	0.230E+02	0.143E+05	0.120E+05	0.131E+03	0.722E+05	-0.205E+03	0.950E+01	0.450E+02
0.300E+00	0.260E+00	0.168E+02	0.917E+04	0.777E+04	0.174E+02	0.917E+04	0.777E+04	0.950E+01	0.450E+02
0.310E+00	0.260E+00	0.161E+02	0.878E+04	0.748E+04	0.167E+02	0.878E+04	0.748E+04	0.950E+01	0.450E+02
0.320E+00	0.260E+00	0.162E+02	0.884E+04	0.754E+04	0.168E+02	0.884E+04	0.754E+04	0.950E+01	0.450E+02
0.330E+00	0.260E+00	0.162E+02	0.884E+04	0.754E+04	0.168E+02	0.884E+04	0.754E+04	0.950E+01	0.450E+02
0.340E+00	0.260E+00	0.162E+02	0.884E+04	0.754E+04	0.168E+02	0.884E+04	0.754E+04	0.950E+01	0.450E+02
0.350E+00	0.260E+00	0.162E+02	0.884E+04	0.754E+04	0.168E+02	0.884E+04	0.754E+04	0.950E+01	0.450E+02
0.360E+00	0.260E+00	0.162E+02	0.884E+04	0.754E+04	0.168E+02	0.884E+04	0.754E+04	0.950E+01	0.450E+02
0.370E+00	0.260E+00	0.162E+02	0.884E+04	0.754E+04	0.168E+02	0.884E+04	0.754E+04	0.950E+01	0.450E+02
0.380E+00	0.260E+00	0.162E+02	0.884E+04	0.754E+04	0.168E+02	0.884E+04	0.754E+04	0.950E+01	0.450E+02
0.390E+00	0.260E+00	0.162E+02	0.884E+04	0.754E+04	0.168E+02	0.884E+04	0.754E+04	0.950E+01	0.450E+02
0.400E+00	0.260E+00	0.162E+02	0.884E+04	0.754E+04	0.168E+02	0.884E+04	0.754E+04	0.950E+01	0.450E+02

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INPUT DATA:

0.400 0.260 0.470 0.827 0.425

9.5 45.0 0 -2 1.800 0.930 0.930 0.960

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SOLID FUEL RAMJET & TRAJECTORY

SUMMARY

AO/AR	A5/AR	TOB	XOB	YOB	TOF	X(MAX)	Y(MAX)	TETP	TETA
0.250E+00	0.250E+00	0.276E+02	0.173E+05	0.134E+05	0.130E+03	0.703E+05	-0.212E+03	0.950E+01	0.450E+02
0.260E+00	0.250E+00	0.258E+02	0.163E+05	0.129E+05	0.130E+03	0.704E+05	-0.348E+02	0.950E+01	0.450E+02
0.270E+00	0.250E+00	0.244E+02	0.156E+05	0.125E+05	0.130E+03	0.713E+05	-0.135E+03	0.950E+01	0.450E+02
0.280E+00	0.250E+00	0.226E+02	0.145E+05	0.118E+05	0.130E+03	0.710E+05	-0.176E+03	0.950E+01	0.450E+02
0.290E+00	0.250E+00	0.201E+02	0.129E+05	0.108E+05	0.129E+03	0.693E+05	-0.700E+02	0.950E+01	0.450E+02
0.300E+00	0.250E+00	0.175E+02	0.957E+04	0.895E+04	0.182E+02	0.957E+04	0.805E+04	0.950E+01	0.450E+02
0.310E+00	0.250E+00	0.168E+02	0.916E+04	0.776E+04	0.175E+02	0.916E+04	0.776E+04	0.950E+01	0.450E+02
0.320E+00	0.250E+00	0.169E+02	0.924E+04	0.782E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.330E+00	0.250E+00	0.169E+02	0.924E+04	0.782E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.340E+00	0.250E+00	0.169E+02	0.924E+04	0.782E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.350E+00	0.250E+00	0.169E+02	0.924E+04	0.782E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.360E+00	0.250E+00	0.169E+02	0.924E+04	0.782E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.370E+00	0.250E+00	0.169E+02	0.924E+04	0.782E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.380E+00	0.250E+00	0.169E+02	0.924E+04	0.782E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.390E+00	0.250E+00	0.169E+02	0.924E+04	0.782E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.400E+00	0.250E+00	0.169E+02	0.924E+04	0.782E+04	0.175E+02	0.924E+04	0.782E+04	0.950E+01	0.450E+02
0.250E+00	0.260E+00	0.305E+02	0.191E+05	0.143E+05	0.130E+03	0.715E+05	-0.840E+02	0.950E+01	0.450E+02
0.260E+00	0.260E+00	0.294E+02	0.186E+05	0.141E+05	0.131E+03	0.730E+05	-0.245E+03	0.950E+01	0.450E+02
0.270E+00	0.260E+00	0.286E+02	0.182E+05	0.140E+05	0.132E+03	0.741E+05	-0.891E+02	0.950E+01	0.450E+02
0.280E+00	0.260E+00	0.274E+02	0.176E+05	0.136E+05	0.133E+03	0.743E+05	-0.616E+02	0.950E+01	0.450E+02
0.290E+00	0.260E+00	0.255E+02	0.165E+05	0.130E+05	0.133E+03	0.750E+05	-0.273E+03	0.950E+01	0.450E+02
0.300E+00	0.260E+00	0.236E+02	0.153E+05	0.124E+05	0.133E+03	0.743E+05	-0.380E+02	0.950E+01	0.450E+02
0.310E+00	0.260E+00	0.168E+02	0.917E+04	0.777E+04	0.174E+02	0.917E+04	0.777E+04	0.950E+01	0.450E+02
0.320E+00	0.260E+00	0.161E+02	0.877E+04	0.748E+04	0.167E+02	0.877E+04	0.748E+04	0.950E+01	0.450E+02
0.330E+00	0.260E+00	0.162E+02	0.884E+04	0.754E+04	0.168E+02	0.884E+04	0.754E+04	0.950E+01	0.450E+02
0.340E+00	0.260E+00	0.162E+02	0.884E+04	0.754E+04	0.168E+02	0.884E+04	0.754E+04	0.950E+01	0.450E+02
0.350E+00	0.260E+00	0.162E+02	0.884E+04	0.754E+04	0.168E+02	0.884E+04	0.754E+04	0.950E+01	0.450E+02
0.360E+00	0.260E+00	0.162E+02	0.884E+04	0.754E+04	0.168E+02	0.884E+04	0.754E+04	0.950E+01	0.450E+02
0.370E+00	0.260E+00	0.162E+02	0.884E+04	0.754E+04	0.168E+02	0.884E+04	0.754E+04	0.950E+01	0.450E+02
0.380E+00	0.260E+00	0.162E+02	0.884E+04	0.754E+04	0.168E+02	0.884E+04	0.754E+04	0.950E+01	0.450E+02
0.390E+00	0.260E+00	0.162E+02	0.884E+04	0.754E+04	0.168E+02	0.884E+04	0.754E+04	0.950E+01	0.450E+02
0.400E+00	0.260E+00	0.162E+02	0.884E+04	0.754E+04	0.168E+02	0.884E+04	0.754E+04	0.950E+01	0.450E+02

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INPUT DATA:

0.400 0.260 0.470 0.910 0.426

9.5 45.0 0 -2 1.800 0.930 0.930 0.960

1 SOLID FUEL RAMJET & TRAJECTORY

SUMMARY

AO/AR	AS/AR	TOB	XOB	YOB	TOF	X(MAX)	Y(MAX)	TETP	TETA
0.250E+00	0.250E+00	0.117E+02	0.609E+04	0.537E+04	0.123E+02	0.609E+04	0.537E+04	0.950E+01	0.450E+02
0.260E+00	0.250E+00	0.117E+02	0.609E+04	0.537E+04	0.123E+02	0.609E+04	0.537E+04	0.950E+01	0.450E+02
0.270E+00	0.250E+00	0.117E+02	0.609E+04	0.537E+04	0.123E+02	0.609E+04	0.537E+04	0.950E+01	0.450E+02
0.280E+00	0.250E+00	0.117E+02	0.609E+04	0.537E+04	0.123E+02	0.609E+04	0.537E+04	0.950E+01	0.450E+02
0.290E+00	0.250E+00	0.117E+02	0.609E+04	0.537E+04	0.123E+02	0.609E+04	0.537E+04	0.950E+01	0.450E+02
0.300E+00	0.250E+00	0.117E+02	0.609E+04	0.537E+04	0.123E+02	0.609E+04	0.537E+04	0.950E+01	0.450E+02
0.310E+00	0.250E+00	0.117E+02	0.609E+04	0.537E+04	0.123E+02	0.609E+04	0.537E+04	0.950E+01	0.450E+02
0.320E+00	0.250E+00	0.117E+02	0.609E+04	0.537E+04	0.123E+02	0.609E+04	0.537E+04	0.950E+01	0.450E+02
0.330E+00	0.250E+00	0.117E+02	0.609E+04	0.537E+04	0.123E+02	0.609E+04	0.537E+04	0.950E+01	0.450E+02
0.340E+00	0.250E+00	0.117E+02	0.609E+04	0.537E+04	0.123E+02	0.609E+04	0.537E+04	0.950E+01	0.450E+02
0.350E+00	0.250E+00	0.117E+02	0.609E+04	0.537E+04	0.123E+02	0.609E+04	0.537E+04	0.950E+01	0.450E+02
0.360E+00	0.250E+00	0.117E+02	0.609E+04	0.537E+04	0.123E+02	0.609E+04	0.537E+04	0.950E+01	0.450E+02
0.370E+00	0.250E+00	0.117E+02	0.609E+04	0.537E+04	0.123E+02	0.609E+04	0.537E+04	0.950E+01	0.450E+02
0.380E+00	0.250E+00	0.117E+02	0.609E+04	0.537E+04	0.123E+02	0.609E+04	0.537E+04	0.950E+01	0.450E+02
0.390E+00	0.250E+00	0.117E+02	0.609E+04	0.537E+04	0.123E+02	0.609E+04	0.537E+04	0.950E+01	0.450E+02
0.400E+00	0.250E+00	0.117E+02	0.609E+04	0.537E+04	0.123E+02	0.609E+04	0.537E+04	0.950E+01	0.450E+02

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INPUT DATA:

C.400 0.260 0.470 0.827 0.270

9.5 45.0 0 -1 1.800 0.930 0.930 0.960

FILE: CMB D A NAVAL POSTGRADUATE SCHOOL PAGE 001

1 SOLID FUEL RAMJET & TRAJECTORY

SUMMARY

AO/AR	AS/AR	TOB	XOB	YOB	TOF	X(MAX)	Y(MAX)	TETP	TETA
0.250E+00	0.250E+00	0.133E+02	0.703E+04	0.612E+04	0.139E+02	0.703E+04	0.612E+04	0.950E+01	0.450E+02
0.260E+00	0.250E+00	0.133E+02	0.703E+04	0.612E+04	0.139E+02	0.703E+04	0.612E+04	0.950E+01	0.450E+02
0.270E+00	0.250E+00	0.133E+02	0.703E+04	0.612E+04	0.139E+02	0.703E+04	0.612E+04	0.950E+01	0.450E+02
0.280E+00	0.250E+00	0.133E+02	0.703E+04	0.612E+04	0.139E+02	0.703E+04	0.612E+04	0.950E+01	0.450E+02
0.290E+00	0.250E+00	0.133E+02	0.703E+04	0.612E+04	0.139E+02	0.703E+04	0.612E+04	0.950E+01	0.450E+02
0.300E+00	0.250E+00	0.133E+02	0.703E+04	0.612E+04	0.139E+02	0.703E+04	0.612E+04	0.950E+01	0.450E+02
0.310E+00	0.250E+00	0.133E+02	0.703E+04	0.612E+04	0.139E+02	0.703E+04	0.612E+04	0.950E+01	0.450E+02
0.320E+00	0.250E+00	0.133E+02	0.703E+04	0.612E+04	0.139E+02	0.703E+04	0.612E+04	0.950E+01	0.450E+02
0.330E+00	0.250E+00	0.133E+02	0.703E+04	0.612E+04	0.139E+02	0.703E+04	0.612E+04	0.950E+01	0.450E+02
0.340E+00	0.250E+00	0.133E+02	0.703E+04	0.612E+04	0.139E+02	0.703E+04	0.612E+04	0.950E+01	0.450E+02
0.350E+00	0.250E+00	0.133E+02	0.703E+04	0.612E+04	0.139E+02	0.703E+04	0.612E+04	0.950E+01	0.450E+02
0.360E+00	0.250E+00	0.133E+02	0.703E+04	0.612E+04	0.139E+02	0.703E+04	0.612E+04	0.950E+01	0.450E+02
0.370E+00	0.250E+00	0.133E+02	0.703E+04	0.612E+04	0.139E+02	0.703E+04	0.612E+04	0.950E+01	0.450E+02
0.380E+00	0.250E+00	0.133E+02	0.703E+04	0.612E+04	0.139E+02	0.703E+04	0.612E+04	0.950E+01	0.450E+02
0.390E+00	0.250E+00	0.133E+02	0.703E+04	0.612E+04	0.139E+02	0.703E+04	0.612E+04	0.950E+01	0.450E+02
0.400E+00	0.250E+00	0.133E+02	0.703E+04	0.612E+04	0.139E+02	0.703E+04	0.612E+04	0.950E+01	0.450E+02
0.250E+00	0.260E+00	0.127E+02	0.669E+04	0.586E+04	0.132E+02	0.669E+04	0.586E+04	0.950E+01	0.450E+02
0.260E+00	0.260E+00	0.127E+02	0.669E+04	0.586E+04	0.132E+02	0.669E+04	0.586E+04	0.950E+01	0.450E+02
0.270E+00	0.260E+00	0.127E+02	0.669E+04	0.586E+04	0.132E+02	0.669E+04	0.586E+04	0.950E+01	0.450E+02
0.280E+00	0.260E+00	0.127E+02	0.669E+04	0.586E+04	0.132E+02	0.669E+04	0.586E+04	0.950E+01	0.450E+02
0.290E+00	0.260E+00	0.127E+02	0.669E+04	0.586E+04	0.132E+02	0.669E+04	0.586E+04	0.950E+01	0.450E+02
0.300E+00	0.260E+00	0.127E+02	0.669E+04	0.586E+04	0.132E+02	0.669E+04	0.586E+04	0.950E+01	0.450E+02
0.310E+00	0.260E+00	0.127E+02	0.669E+04	0.586E+04	0.132E+02	0.669E+04	0.586E+04	0.950E+01	0.450E+02
0.320E+00	0.260E+00	0.127E+02	0.669E+04	0.586E+04	0.132E+02	0.669E+04	0.586E+04	0.950E+01	0.450E+02
0.330E+00	0.260E+00	0.127E+02	0.669E+04	0.586E+04	0.132E+02	0.669E+04	0.586E+04	0.950E+01	0.450E+02
0.340E+00	0.260E+00	0.127E+02	0.669E+04	0.586E+04	0.132E+02	0.669E+04	0.586E+04	0.950E+01	0.450E+02
0.350E+00	0.260E+00	0.127E+02	0.669E+04	0.586E+04	0.132E+02	0.669E+04	0.586E+04	0.950E+01	0.450E+02
0.360E+00	0.260E+00	0.127E+02	0.669E+04	0.586E+04	0.132E+02	0.669E+04	0.586E+04	0.950E+01	0.450E+02
0.370E+00	0.260E+00	0.127E+02	0.669E+04	0.586E+04	0.132E+02	0.669E+04	0.586E+04	0.950E+01	0.450E+02
0.380E+00	0.260E+00	0.127E+02	0.669E+04	0.586E+04	0.132E+02	0.669E+04	0.586E+04	0.950E+01	0.450E+02
0.390E+00	0.260E+00	0.127E+02	0.669E+04	0.586E+04	0.132E+02	0.669E+04	0.586E+04	0.950E+01	0.450E+02
0.400E+00	0.260E+00	0.127E+02	0.669E+04	0.586E+04	0.132E+02	0.669E+04	0.586E+04	0.950E+01	0.450E+02

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INPUT DATA:

0.400 0.260 0.470 0.827 0.320

9.5 45.0 0 -2 1.800 0.930 0.930 0.960

1 SOLID FUEL RAMJET & TRAJECTORY

SUMMARY

AO/AR	A5/AR	TOB	XOB	YOB	TOF	X(MAX)	Y(MAX)	TFTP	TFTA
0.250E+00	0.250E+00	0.265E+02	0.168E+05	0.131E+05	0.129E+03	0.700E+05	-0.222E+02	0.950E+01	0.450E+02
0.270E+00	0.250E+00	0.236E+02	0.153E+05	0.123E+05	0.131E+03	0.710E+05	-0.178E+03	0.950E+01	0.450E+02
0.290E+00	0.250E+00	0.193E+02	0.125E+05	0.106E+05	0.129E+03	0.687E+05	-0.265E+03	0.950E+01	0.450E+02
0.310E+00	0.250E+00	0.122E+02	0.799E+04	0.721E+04	0.431E+02	0.752E+05	0.166E+05	0.950E+01	0.450E+02
0.330E+00	0.250E+00	0.187E+02	0.103E+05	0.859E+04	0.193E+02	0.103E+05	0.859E+04	0.950E+01	0.450E+02
0.340E+00	0.250E+00	0.187E+02	0.104E+05	0.854E+04	0.194E+02	0.104E+05	0.864E+04	0.950E+01	0.450E+02
0.350E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.450E+02
0.360E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.450E+02
0.370E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.450E+02
0.380E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.450E+02
0.390E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.450E+02
0.400E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.450E+02
0.250E+00	0.260E+00	0.295E+02	0.186E+05	0.141E+05	0.130E+03	0.716E+05	-0.143E+03	0.950E+01	0.450E+02
0.260E+00	0.260E+00	0.284E+02	0.181E+05	0.139E+05	0.131E+03	0.724E+05	-0.909E+02	0.950E+01	0.450E+02
0.270E+00	0.260E+00	0.276E+02	0.177E+05	0.137E+05	0.132E+03	0.739E+05	-0.246E+03	0.950E+01	0.450E+02
0.280E+00	0.260E+00	0.257E+02	0.166E+05	0.131E+05	0.132E+03	0.740E+05	-0.147E+03	0.950E+01	0.450E+02
0.290E+00	0.260E+00	0.244E+02	0.158E+05	0.127E+05	0.133E+03	0.744E+05	-0.263E+03	0.950E+01	0.450E+02
0.300E+00	0.260E+00	0.218E+02	0.142E+05	0.117E+05	0.132E+03	0.729E+05	-0.559E+02	0.950E+01	0.450E+02
0.310E+00	0.260E+00	0.186E+02	0.121E+05	0.103E+05	0.130E+03	0.697E+05	-0.138E+03	0.950E+01	0.450E+02
0.320E+00	0.260E+00	0.135E+02	0.810E+04	0.745E+04	0.498E+02	0.284E+05	0.178E+05	0.950E+01	0.450E+02
0.330E+00	0.260E+00	0.197E+02	0.717E+04	0.655E+04	0.404E+02	0.235E+05	0.160E+05	0.950E+01	0.450E+02
0.340E+00	0.260E+00	0.186E+02	0.103E+05	0.858E+04	0.193E+02	0.103E+05	0.858E+04	0.950E+01	0.450E+02
0.350E+00	0.260E+00	0.179E+02	0.987E+04	0.829E+04	0.185E+02	0.987E+04	0.829E+04	0.950E+01	0.450E+02
0.360E+00	0.260E+00	0.180E+02	0.995E+04	0.836E+04	0.186E+02	0.995E+04	0.836E+04	0.950E+01	0.450E+02
0.370E+00	0.260E+00	0.180E+02	0.995E+04	0.836E+04	0.186E+02	0.995E+04	0.836E+04	0.950E+01	0.450E+02
0.380E+00	0.260E+00	0.180E+02	0.995E+04	0.836E+04	0.186E+02	0.995E+04	0.836E+04	0.950E+01	0.450E+02
0.390E+00	0.260E+00	0.180E+02	0.995E+04	0.836E+04	0.186E+02	0.995E+04	0.836E+04	0.950E+01	0.450E+02
0.400E+00	0.260E+00	0.180E+02	0.995E+04	0.836E+04	0.186E+02	0.995E+04	0.836E+04	0.950E+01	0.450E+02

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INPUT DATA:

0.400 0.260 0.470 0.827 0.470

9.5 45.0 0 -2 1.800 0.930 0.930 0.960

1 SOLID FUEL RAMJET & TRAJECTORY

SUMMARY

AO/AR	AS/AR	TOB	XOB	YOB	TOF	X(MAX)	Y(MAX)	TETP	TETA
0.250E+00	0.250E+00	0.388E+02	0.259E+05	0.181E+05	0.138E+03	0.841E+05	-0.190E+03	0.650E+01	0.450E+02
0.260E+00	0.250E+00	0.371E+02	0.250E+05	0.178E+05	0.140E+03	0.854E+05	-0.305E+03	0.650E+01	0.450E+02
0.270E+00	0.250E+00	0.363E+02	0.246E+05	0.178E+05	0.140E+03	0.872E+05	-0.305E+02	0.650E+01	0.450E+02
0.280E+00	0.250E+00	0.351E+02	0.240E+05	0.176E+05	0.142E+03	0.887E+05	-0.119E+03	0.650E+01	0.450E+02
0.290E+00	0.250E+00	0.338E+02	0.233E+05	0.173E+05	0.143E+03	0.901E+05	-0.260E+03	0.650E+01	0.450E+02
0.300E+00	0.250E+00	0.345E+02	0.158E+05	0.114E+05	0.351E+02	0.169E+05	0.114E+05	0.650E+01	0.450E+02
0.310E+00	0.250E+00	0.324E+02	0.158E+05	0.110E+05	0.331E+02	0.158E+05	0.110E+05	0.650E+01	0.450E+02
0.320E+00	0.250E+00	0.332E+02	0.162E+05	0.111E+05	0.338E+02	0.162E+05	0.111E+05	0.650E+01	0.450E+02
0.330E+00	0.250E+00	0.332E+02	0.162E+05	0.111E+05	0.338E+02	0.162E+05	0.111E+05	0.650E+01	0.450E+02
0.340E+00	0.250E+00	0.332E+02	0.162E+05	0.111E+05	0.338E+02	0.162E+05	0.111E+05	0.650E+01	0.450E+02
0.350E+00	0.250E+00	0.332E+02	0.162E+05	0.111E+05	0.338E+02	0.162E+05	0.111E+05	0.650E+01	0.450E+02
0.360E+00	0.250E+00	0.332E+02	0.162E+05	0.111E+05	0.338E+02	0.162E+05	0.111E+05	0.650E+01	0.450E+02
0.370E+00	0.250E+00	0.332E+02	0.162E+05	0.111E+05	0.338E+02	0.162E+05	0.111E+05	0.650E+01	0.450E+02
0.380E+00	0.250E+00	0.332E+02	0.162E+05	0.111E+05	0.338E+02	0.162E+05	0.111E+05	0.650E+01	0.450E+02
0.390E+00	0.250E+00	0.332E+02	0.162E+05	0.111E+05	0.338E+02	0.162E+05	0.111E+05	0.650E+01	0.450E+02
0.400E+00	0.250E+00	0.332E+02	0.162E+05	0.111E+05	0.338E+02	0.162E+05	0.111E+05	0.650E+01	0.450E+02
0.250E+00	0.260E+00	0.417E+02	0.277E+05	0.197E+05	0.138E+03	0.841E+05	-0.176E+03	0.650E+01	0.450E+02
0.260E+00	0.260E+00	0.406E+02	0.272E+05	0.187E+05	0.139E+03	0.861E+05	-0.154E+03	0.650E+01	0.450E+02
0.270E+00	0.260E+00	0.398E+02	0.259E+05	0.197E+05	0.141E+03	0.878E+05	-0.156E+03	0.650E+01	0.450E+02
0.280E+00	0.260E+00	0.386E+02	0.263E+05	0.196E+05	0.142E+03	0.893E+05	-0.192E+03	0.650E+01	0.450E+02
0.290E+00	0.260E+00	0.373E+02	0.257E+05	0.194E+05	0.143E+03	0.910E+05	-0.288E+03	0.650E+01	0.450E+02
0.300E+00	0.260E+00	0.124E+01	0.114E+04	0.113E+04	0.398E+02	0.194E+05	0.124E+05	0.650E+01	0.450E+02
0.310E+00	0.260E+00	0.316E+02	0.154E+05	0.104E+05	0.322E+02	0.154E+05	0.108E+05	0.650E+01	0.450E+02
0.320E+00	0.260E+00	0.317E+02	0.155E+05	0.108E+05	0.323E+02	0.155E+05	0.108E+05	0.650E+01	0.450E+02
0.330E+00	0.260E+00	0.323E+02	0.157E+05	0.109E+05	0.330E+02	0.157E+05	0.109E+05	0.650E+01	0.450E+02
0.340E+00	0.260E+00	0.323E+02	0.157E+05	0.109E+05	0.330E+02	0.157E+05	0.109E+05	0.650E+01	0.450E+02
0.350E+00	0.260E+00	0.323E+02	0.157E+05	0.109E+05	0.330E+02	0.157E+05	0.109E+05	0.650E+01	0.450E+02
0.360E+00	0.260E+00	0.323E+02	0.157E+05	0.109E+05	0.330E+02	0.157E+05	0.109E+05	0.650E+01	0.450E+02
0.370E+00	0.260E+00	0.323E+02	0.157E+05	0.109E+05	0.330E+02	0.157E+05	0.109E+05	0.650E+01	0.450E+02
0.380E+00	0.260E+00	0.323E+02	0.157E+05	0.109E+05	0.330E+02	0.157E+05	0.109E+05	0.650E+01	0.450E+02
0.390E+00	0.260E+00	0.323E+02	0.157E+05	0.109E+05	0.330E+02	0.157E+05	0.109E+05	0.650E+01	0.450E+02
0.400E+00	0.260E+00	0.323E+02	0.157E+05	0.109E+05	0.330E+02	0.157E+05	0.109E+05	0.650E+01	0.450E+02

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INPUT DATA:

0.400 0.260 0.470 0.827 0.475

6.5 45.0 0 -2 1.400 0.930 0.930 0.960

FILE: CMB D A NAVAL POSTGRADUATE SCHOOL PAGE 001

1 SOLID FUEL RAMJET & TRAJECTORY

SUMMARY

AO/AR	A5/AR	TOB	XOB	YOB	TOF	X(MAX)	Y(MAX)	TETP	TETA
0.250E+00	0.250E+00	0.288E+02	0.186E+05	0.143E+05	0.133E+03	0.727E+05	-0.113E+03	0.115E+02	0.450E+02
0.260E+00	0.250E+00	0.283E+02	0.184E+05	0.143E+05	0.134E+03	0.747E+05	-0.152E+03	0.115E+02	0.450E+02
0.270E+00	0.250E+00	0.501E+01	0.346E+04	0.332E+04	0.426E+02	0.214E+05	0.135E+05	0.115E+02	0.450E+02
0.280E+00	0.250E+00	0.250E+01	0.191E+04	0.187E+04	0.331E+02	0.160E+05	0.114E+05	0.115E+02	0.450E+02
0.290E+00	0.250E+00	0.175E+01	0.115E+04	0.114E+04	0.288E+02	0.139E+05	0.103E+05	0.115E+02	0.450E+02
0.300E+00	0.250E+00	0.244E+02	0.119E+05	0.917E+04	0.251E+02	0.119E+05	0.917E+04	0.115E+02	0.450E+02
0.310E+00	0.250E+00	0.238E+02	0.117E+05	0.904E+04	0.244E+02	0.117E+05	0.904E+04	0.115E+02	0.450E+02
0.320E+00	0.250E+00	0.238E+02	0.117E+05	0.905E+04	0.244E+02	0.117E+05	0.905E+04	0.115E+02	0.450E+02
0.330E+00	0.250E+00	0.239E+02	0.117E+05	0.905E+04	0.244E+02	0.117E+05	0.905E+04	0.115E+02	0.450E+02
0.340E+00	0.250E+00	0.238E+02	0.117E+05	0.905E+04	0.244E+02	0.117E+05	0.905E+04	0.115E+02	0.450E+02
0.350E+00	0.250E+00	0.238E+02	0.117E+05	0.905E+04	0.244E+02	0.117E+05	0.905E+04	0.115E+02	0.450E+02
0.360E+00	0.250E+00	0.238E+02	0.117E+05	0.905E+04	0.244E+02	0.117E+05	0.905E+04	0.115E+02	0.450E+02
0.370E+00	0.250E+00	0.238E+02	0.117E+05	0.905E+04	0.244E+02	0.117E+05	0.905E+04	0.115E+02	0.450E+02
0.380E+00	0.250E+00	0.238E+02	0.117E+05	0.905E+04	0.244E+02	0.117E+05	0.905E+04	0.115E+02	0.450E+02
0.390E+00	0.250E+00	0.238E+02	0.117E+05	0.905E+04	0.244E+02	0.117E+05	0.905E+04	0.115E+02	0.450E+02
0.400E+00	0.250E+00	0.238E+02	0.117E+05	0.905E+04	0.244E+02	0.117E+05	0.905E+04	0.115E+02	0.450E+02
0.250E+00	0.260E+00	0.311E+02	0.199E+05	0.149E+05	0.133E+03	0.732E+05	-0.176E+03	0.115E+02	0.450E+02
0.260E+00	0.260E+00	0.306E+02	0.198E+05	0.150E+05	0.134E+03	0.752E+05	-0.181E+03	0.115E+02	0.450E+02
0.270E+00	0.260E+00	0.299E+02	0.195E+05	0.149E+05	0.136E+03	0.769E+05	-0.251E+03	0.115E+02	0.450E+02
0.280E+00	0.260E+00	0.498E+01	0.342E+04	0.328E+04	0.429E+02	0.215E+05	0.135E+05	0.115E+02	0.450E+02
0.290E+00	0.260E+00	0.186E+01	0.151E+04	0.149E+04	0.304E+02	0.147E+05	0.107E+05	0.115E+02	0.450E+02
0.300E+00	0.260E+00	0.236E+02	0.115E+05	0.894E+04	0.242E+02	0.115E+05	0.894E+04	0.115E+02	0.450E+02
0.310E+00	0.260E+00	0.236E+02	0.115E+05	0.892E+04	0.242E+02	0.115E+05	0.892E+04	0.115E+02	0.450E+02
0.320E+00	0.260E+00	0.236E+02	0.115E+05	0.894E+04	0.243E+02	0.115E+05	0.894E+04	0.115E+02	0.450E+02
0.330E+00	0.260E+00	0.236E+02	0.115E+05	0.894E+04	0.243E+02	0.115E+05	0.894E+04	0.115E+02	0.450E+02
0.340E+00	0.260E+00	0.236E+02	0.115E+05	0.894E+04	0.243E+02	0.115E+05	0.894E+04	0.115E+02	0.450E+02
0.350E+00	0.260E+00	0.236E+02	0.115E+05	0.894E+04	0.243E+02	0.115E+05	0.894E+04	0.115E+02	0.450E+02
0.360E+00	0.260E+00	0.236E+02	0.115E+05	0.894E+04	0.243E+02	0.115E+05	0.894E+04	0.115E+02	0.450E+02
0.370E+00	0.260E+00	0.236E+02	0.115E+05	0.894E+04	0.243E+02	0.115E+05	0.894E+04	0.115E+02	0.450E+02
0.380E+00	0.260E+00	0.236E+02	0.115E+05	0.894E+04	0.243E+02	0.115E+05	0.894E+04	0.115E+02	0.450E+02
0.390E+00	0.260E+00	0.236E+02	0.115E+05	0.894E+04	0.243E+02	0.115E+05	0.894E+04	0.115E+02	0.450E+02
0.400E+00	0.260E+00	0.236E+02	0.115E+05	0.894E+04	0.243E+02	0.115E+05	0.894E+04	0.115E+02	0.450E+02

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INPUT DATA:

0.400 0.260 0.470 0.827 0.425

11.5 45.0 0 -2 1.400 0.930 0.930 0.960

H2. DETAILED RESULTS

A_0/A_r	A_1/A_0	A_2/A_0	A_3/A_r	A_5/A_r	θ_p	θ
0.28	0.47	0.827	0.426	0.26	9.5	15
0.28	0.42	0.827	0.426	0.26	9.5	45
0.28	0.47	0.887	0.426	0.26	9.5	45
0.28	0.47	0.91	0.426	0.26	9.5	45
0.28	0.47	0.827	0.47	0.26	9.5	45
0.25	0.47	0.827	0.426	0.26	9.5	60
0.28	0.47	0.827	0.426	0.26	6.5	45

FILE: CMB D : A NAVAL POSTGRADUATE SCHOOL PAGE 001

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CCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
CCC                        CCC
CCC    SOLID FUEL RAMJET   CCC
CCC                        CCC
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
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GEOMETRICAL DATA:

AREF= C.1245E-01M2 L3= 0.5842E+00M TETP= 9.5

A0/AREF	A1C/A0	A1/A0	A2/A0	A3/AREF	A5/AREF	A6/A5
0.2800	0.8194	0.4700	0.8269	0.4259	0.2600	3.8462

M0	M1C	M6
2.5336	2.3136	2.6646

CONSTANT LOSSES:

PID1= 0.930 PID2= 0.930 PIN= 0.960

INITIAL FLIGHT CONDITIONS:

PO(KG/M2)	TO(K)	ROO(KG/M3)	PTO(KG/M2)	TTO(K)	GA
0.103E+05	0.288E+03	0.122E+01	0.186E+06	0.658E+03	1.400

TIME	MO	AS/AO	WA	WF/WA	M2	M3N	M3I	M4	TOTAL PRES. RATIOS 1C/0	12/11	3/2	4/3	6/0	GF	TT4(K)	CF	F(N)	ISP
0.23	2.53	C.509	2.929	6.596	0.329	0.163	0.180	0.391	0.996	0.838	0.949	0.940	0.620	1.25	2258.8	0.242	1370.6	7094.8
0.46	2.53	0.509	2.929	6.587	0.329	0.161	0.177	0.385	0.996	0.838	0.949	0.941	0.619	1.25	2257.4	0.241	1368.1	7092.2
0.68	2.53	C.509	2.911	6.593	0.329	0.159	0.175	0.378	0.996	0.837	0.948	0.943	0.621	1.25	2257.7	0.244	1373.8	7157.2
0.91	2.53	0.509	2.901	6.593	0.329	0.157	0.173	0.372	0.996	0.838	0.947	0.944	0.622	1.25	2257.3	0.246	1376.5	7195.8
1.14	2.53	0.503	2.891	6.593	0.326	0.155	0.169	0.366	0.996	0.844	0.948	0.946	0.623	1.25	2257.0	0.248	1378.4	7231.0
1.37	2.53	C.503	2.881	6.595	0.326	0.153	0.167	0.361	0.996	0.844	0.947	0.947	0.624	1.25	2256.8	0.249	1379.8	7262.6
1.59	2.53	C.503	2.870	6.596	0.326	0.151	0.165	0.355	0.996	0.844	0.947	0.949	0.625	1.25	2256.7	0.251	1380.7	7294.1
1.82	2.53	C.503	2.859	6.598	0.326	0.149	0.163	0.350	0.996	0.844	0.946	0.950	0.626	1.25	2256.6	0.252	1381.2	7322.2
2.05	2.53	C.503	2.848	6.603	0.326	0.148	0.161	0.345	0.996	0.844	0.946	0.951	0.627	1.25	2256.6	0.254	1381.3	7348.5
2.28	2.53	C.503	2.837	6.602	0.326	0.146	0.159	0.341	0.996	0.844	0.946	0.952	0.627	1.25	2256.7	0.255	1381.0	7372.8
2.50	2.54	C.503	2.826	6.605	0.326	0.144	0.157	0.336	0.996	0.844	0.945	0.953	0.628	1.25	2256.8	0.256	1380.5	7395.4
2.73	2.54	C.503	2.815	6.608	0.326	0.143	0.155	0.332	0.996	0.843	0.945	0.954	0.628	1.25	2257.0	0.257	1379.6	7416.6
2.96	2.54	0.503	2.804	6.611	0.326	0.141	0.153	0.328	0.996	0.843	0.945	0.955	0.628	1.25	2257.2	0.258	1378.6	7436.7
3.19	2.54	0.503	2.793	6.614	0.326	0.140	0.152	0.324	0.996	0.843	0.944	0.956	0.629	1.25	2257.4	0.259	1377.4	7455.5
3.42	2.54	0.503	2.782	6.618	0.325	0.139	0.150	0.320	0.996	0.842	0.944	0.957	0.628	1.25	2257.7	0.260	1375.9	7472.7
3.64	2.54	C.503	2.771	6.621	0.325	0.137	0.149	0.316	0.996	0.842	0.944	0.958	0.628	1.25	2258.0	0.261	1374.1	7488.3
3.87	2.54	C.503	2.761	6.625	0.325	0.136	0.147	0.313	0.996	0.841	0.943	0.959	0.628	1.25	2258.4	0.261	1372.3	7502.1
4.10	2.54	0.503	2.750	6.629	0.325	0.135	0.146	0.309	0.996	0.841	0.943	0.960	0.628	1.25	2258.7	0.262	1370.2	7516.7
4.33	2.54	C.503	2.739	6.633	0.325	0.133	0.144	0.306	0.996	0.840	0.943	0.960	0.628	1.25	2259.1	0.263	1367.9	7528.7
4.55	2.54	C.503	2.729	6.636	0.325	0.132	0.143	0.303	0.996	0.840	0.943	0.961	0.628	1.25	2259.6	0.263	1365.5	7539.9
4.78	2.54	0.503	2.718	6.640	0.325	0.131	0.141	0.300	0.996	0.839	0.943	0.962	0.628	1.25	2260.0	0.264	1363.0	7550.8
5.01	2.55	C.503	2.708	6.645	0.325	0.130	0.140	0.297	0.996	0.838	0.942	0.963	0.627	1.25	2260.4	0.265	1360.4	7560.5
5.24	2.55	C.503	2.698	6.649	0.325	0.129	0.139	0.293	0.996	0.838	0.942	0.963	0.627	1.25	2260.9	0.265	1357.7	7569.3
5.46	2.55	C.503	2.688	6.653	0.325	0.127	0.137	0.291	0.996	0.837	0.942	0.964	0.626	1.25	2261.4	0.266	1354.9	7576.8
5.69	2.55	C.503	2.678	6.657	0.324	0.126	0.136	0.291	0.996	0.836	0.942	0.964	0.626	1.25	2261.9	0.266	1351.9	7582.7
5.92	2.55	0.503	2.668	6.661	0.324	0.125	0.135	0.286	0.996	0.836	0.942	0.965	0.625	1.25	2262.4	0.266	1348.6	7589.3
6.15	2.55	C.509	2.658	6.666	0.327	0.124	0.135	0.283	0.996	0.828	0.941	0.966	0.625	1.25	2263.0	0.267	1345.5	7594.8
6.38	2.55	0.509	2.648	6.670	0.327	0.123	0.134	0.281	0.996	0.828	0.940	0.966	0.624	1.25	2263.5	0.267	1342.2	7599.1
6.60	2.55	0.509	2.638	6.674	0.327	0.122	0.133	0.278	0.996	0.827	0.940	0.967	0.623	1.25	2263.8	0.267	1338.5	7600.5

6.83	2.56	0.509	2.629	6.679	0.327	0.121	0.132	0.276	0.996	0.826	0.940	0.967	0.623	1.25	2264.2	0.267	1334.7	7601.6
7.06	2.56	0.509	2.620	6.683	0.326	0.120	0.131	0.273	0.996	0.825	0.940	0.968	0.622	1.25	2264.5	0.267	1330.9	7602.3
7.29	2.56	0.509	2.610	6.687	0.326	0.120	0.130	0.271	0.996	0.825	0.940	0.969	0.621	1.25	2264.8	0.268	1327.0	7601.9
7.51	2.56	0.509	2.601	6.692	0.326	0.119	0.129	0.269	0.996	0.824	0.940	0.969	0.620	1.25	2265.2	0.268	1323.1	7601.3
7.74	2.56	0.509	2.592	6.696	0.326	0.118	0.128	0.267	0.996	0.823	0.940	0.969	0.620	1.25	2265.5	0.268	1319.2	7600.3
7.97	2.56	0.509	2.583	6.700	0.326	0.117	0.127	0.265	0.996	0.822	0.940	0.970	0.619	1.25	2265.8	0.268	1315.3	7598.9
8.20	2.56	0.509	2.574	6.705	0.326	0.116	0.126	0.262	0.996	0.821	0.939	0.970	0.618	1.25	2266.2	0.268	1311.4	7597.3
8.43	2.57	0.509	2.566	6.709	0.326	0.115	0.125	0.260	0.996	0.821	0.939	0.970	0.617	1.25	2266.5	0.268	1307.4	7595.2
8.65	2.57	0.509	2.557	6.713	0.325	0.115	0.124	0.259	0.996	0.820	0.939	0.971	0.616	1.25	2266.9	0.268	1303.5	7592.8
8.89	2.57	0.515	2.549	6.717	0.328	0.114	0.124	0.257	0.996	0.817	0.938	0.971	0.615	1.25	2267.2	0.268	1299.6	7590.2
9.11	2.57	0.515	2.541	6.722	0.328	0.113	0.123	0.255	0.996	0.812	0.938	0.972	0.614	1.25	2267.6	0.268	1295.7	7587.2
9.34	2.57	0.515	2.532	6.726	0.328	0.112	0.122	0.253	0.996	0.811	0.938	0.972	0.614	1.25	2267.9	0.268	1291.7	7583.9
9.56	2.57	0.515	2.524	6.730	0.328	0.112	0.121	0.251	0.996	0.810	0.938	0.972	0.613	1.25	2268.3	0.268	1287.8	7580.3
9.79	2.58	0.515	2.517	6.734	0.328	0.111	0.120	0.249	0.996	0.809	0.938	0.973	0.612	1.25	2268.6	0.267	1283.9	7576.4
10.02	2.58	0.515	2.509	6.738	0.328	0.110	0.120	0.248	0.996	0.808	0.938	0.973	0.611	1.25	2269.0	0.267	1280.1	7572.8
10.25	2.58	0.515	2.501	6.742	0.327	0.109	0.119	0.246	0.996	0.808	0.938	0.973	0.610	1.25	2269.3	0.267	1276.3	7568.9
10.47	2.58	0.515	2.494	6.745	0.327	0.109	0.118	0.244	0.996	0.807	0.938	0.974	0.609	1.25	2269.6	0.267	1272.5	7564.8
10.70	2.58	0.515	2.486	6.749	0.327	0.108	0.117	0.243	0.996	0.806	0.938	0.974	0.608	1.25	2270.0	0.267	1268.7	7560.3
10.93	2.58	0.515	2.479	6.753	0.327	0.107	0.116	0.241	0.996	0.805	0.937	0.974	0.607	1.25	2270.3	0.267	1264.9	7555.7
11.16	2.58	0.515	2.472	6.757	0.327	0.107	0.116	0.239	0.996	0.804	0.937	0.975	0.606	1.25	2270.6	0.267	1261.1	7550.6
11.39	2.59	0.515	2.465	6.760	0.327	0.106	0.115	0.238	0.996	0.804	0.937	0.975	0.605	1.25	2271.0	0.267	1257.4	7546.0
11.61	2.59	0.515	2.458	6.764	0.327	0.106	0.114	0.236	0.996	0.803	0.937	0.975	0.605	1.25	2271.3	0.266	1253.8	7541.1
11.84	2.59	0.515	2.451	6.767	0.326	0.105	0.114	0.235	0.996	0.802	0.937	0.976	0.604	1.25	2271.6	0.266	1250.1	7535.9
12.07	2.59	0.520	2.445	6.770	0.329	0.104	0.114	0.233	0.996	0.795	0.936	0.976	0.603	1.25	2271.9	0.266	1245.5	7530.5
12.30	2.59	0.520	2.438	6.774	0.329	0.104	0.113	0.232	0.996	0.794	0.936	0.976	0.602	1.25	2272.2	0.266	1242.9	7524.8
12.52	2.59	0.520	2.432	6.777	0.329	0.103	0.112	0.231	0.996	0.793	0.936	0.976	0.601	1.25	2272.5	0.266	1239.3	7519.5
12.75	2.59	0.520	2.426	6.780	0.329	0.103	0.112	0.229	0.996	0.793	0.936	0.977	0.600	1.25	2272.8	0.265	1235.8	7513.9
12.98	2.60	0.520	2.420	6.783	0.329	0.102	0.111	0.228	0.996	0.792	0.936	0.977	0.599	1.25	2273.1	0.265	1232.3	7508.2
13.21	2.60	0.520	2.414	6.786	0.329	0.102	0.110	0.227	0.996	0.791	0.936	0.977	0.598	1.25	2273.4	0.265	1228.9	7502.8
13.43	2.60	0.520	2.408	6.789	0.329	0.101	0.110	0.225	0.996	0.790	0.936	0.977	0.597	1.25	2273.6	0.265	1225.6	7497.0
13.66	2.60	0.520	2.402	6.791	0.328	0.100	0.109	0.224	0.996	0.790	0.936	0.978	0.596	1.25	2273.9	0.265	1222.2	7491.1
13.89	2.60	0.520	2.397	6.794	0.328	0.100	0.109	0.223	0.996	0.789	0.936	0.978	0.596	1.25	2274.1	0.264	1218.9	7485.1
14.12	2.60	0.520	2.391	6.796	0.328	0.099	0.108	0.221	0.996	0.788	0.936	0.978	0.595	1.25	2274.4	0.264	1215.6	7479.3
14.35	2.60	0.526	2.386	6.799	0.331	0.099	0.108	0.220	0.996	0.781	0.935	0.978	0.594	1.25	2274.6	0.264	1212.4	7473.4
14.57	2.60	0.526	2.381	6.801	0.331	0.098	0.108	0.219	0.996	0.781	0.935	0.979	0.593	1.25	2274.9	0.264	1209.2	7467.2
14.80	2.61	0.526	2.376	6.803	0.331	0.098	0.107	0.218	0.996	0.780	0.934	0.979	0.592	1.25	2275.1	0.263	1206.1	7461.4
15.03	2.61	0.526	2.371	6.805	0.331	0.097	0.107	0.217	0.996	0.779	0.934	0.979	0.591	1.25	2275.3	0.263	1203.0	7455.3
15.26	2.61	0.526	2.366	6.807	0.331	0.097	0.106	0.215	0.996	0.779	0.934	0.979	0.590	1.25	2275.5	0.263	1199.9	7449.0
15.48	2.61	0.526	2.362	6.809	0.330	0.096	0.105	0.214	0.996	0.778	0.934	0.979	0.590	1.25	2275.7	0.262	1197.0	7443.1
15.71	2.61	0.526	2.357	6.811	0.330	0.096	0.105	0.213	0.996	0.777	0.934	0.980	0.589	1.25	2275.9	0.262	1194.0	7436.9
15.94	2.61	0.526	2.353	6.813	0.330	0.095	0.104	0.212	0.995	0.777	0.934	0.980	0.588	1.25	2276.1	0.262	1191.1	7430.6
16.17	2.61	0.526	2.349	6.814	0.330	0.095	0.104	0.211	0.995	0.776	0.934	0.980	0.587	1.25	2276.3	0.262	1188.2	7424.6
16.39	2.61	0.526	2.345	6.815	0.330	0.095	0.103	0.210	0.995	0.775	0.934	0.980	0.586	1.25	2276.4	0.261	1185.4	7418.5
16.62	2.61	0.526	2.341	6.817	0.330	0.094	0.103	0.209	0.995	0.775	0.934	0.980	0.586	1.25	2276.6	0.261	1182.6	7412.2
16.85	2.62	0.526	2.337	6.818	0.330	0.094	0.102	0.208	0.995	0.774	0.934	0.981	0.585	1.25	2276.7	0.261	1179.9	7406.1
17.08	2.62	0.526	2.333	6.819	0.330	0.093	0.102	0.207	0.995	0.774	0.934	0.981	0.584	1.25	2276.9	0.261	1177.2	7399.9
17.31	2.62	0.526	2.329	6.820	0.330	0.093	0.101	0.205	0.995	0.773	0.934	0.981	0.583	1.25	2277.0	0.260	1174.6	7394.1
17.53	2.62	0.531	2.326	6.821	0.333	0.092	0.101	0.204	0.995	0.766	0.933	0.981	0.583	1.25	2277.1	0.260	1172.1	7388.1
17.76	2.62	0.531	2.323	6.821	0.332	0.092	0.101	0.203	0.995	0.766	0.933	0.981	0.582	1.25	2277.2	0.259	1169.5	7381.8
17.99	2.62	0.531	2.319	6.822	0.332	0.092	0.100	0.202	0.995	0.765	0.933	0.982	0.581	1.25	2277.3	0.259	1167.1	7375.9
18.22	2.62	0.531	2.316	6.822	0.332	0.091	0.100	0.201	0.995	0.765	0.933	0.982	0.580	1.25	2277.4	0.259	1164.6	7369.9
18.44	2.62	0.531	2.313	6.823	0.332	0.091	0.099	0.200	0.995	0.764	0.933	0.982	0.580	1.25	2277.5	0.258	1162.2	7363.6
18.67	2.62	0.531	2.311	6.823	0.332	0.090	0.099	0.199	0.995	0.764	0.933	0.982	0.579	1.25	2277.5	0.258	1159.9	7357.7
18.90	2.62	0.531	2.308	6.823	0.332	0.090	0.099	0.199	0.995	0.763	0.933	0.982	0.578	1.25	2277.6	0.258	1157.6	7351.7
19.13	2.63	0.531	2.305	6.823	0.332	0.090	0.098	0.198	0.995	0.763	0.933	0.982	0.578	1.25	2277.6	0.258	1155.4	7346.0
19.36	2.63	0.531	2.303	6.822	0.332	0.089	0.098	0.197	0.995	0.762	0.933	0.983	0.577	1.25	2277.6	0.257	1153.2	7340.1
19.58	2.63	0.531	2.301	6.822	0.332	0.089	0.097	0.196	0.995	0.762	0.933	0.983	0.576	1.25	2277.6	0.257	1151.1	7334.6
19.81	2.63	0.531	2.298	6.822	0.332	0.088	0.097	0.195	0.995	0.761	0.933	0.983	0.576	1.25	2277.7	0.257	1149.1	7328.9
20.04	2.63	0.531	2.296	6.821	0.332	0.088	0.096	0.194	0.995	0.761	0.933	0.983	0.575	1.25	2277.6	0.256	1147.0	7323.1
20.27	2.63	0.531	2.294	6.820	0.332	0.088	0.096	0.193	0.995	0.760	0.933	0.983	0.574	1.25	2277.6	0.256	1145.1	7317.6
20.49	2.63	0.537	2.293	6.819	0.335	0.087	0.096	0.192	0.995	0.754	0.931	0.983	0.574	1.25	2277.6	0.255	1143.1	7311.9
20.72	2.63	0.537	2.291	6.818	0.334	0.087	0.096	0.191	0.995	0.753	0.931	0.983	0.573	1.25	2277.6	0.255	1141.3	7306.6
20.95	2.63	0.537	2.289	6.817	0.334	0.086	0.095	0.190	0.995	0.753	0.931	0.984	0.572	1.25	2277.5	0.255	1139.5	7301.1
21.18	2.63	0.537	2.288	6.816	0.334	0.086	0.095	0.189	0.995	0.753	0.931	0.984	0.572	1.25	2277.5	0.254	1137.7	7295.4
21.40	2.63	0.537	2.287	6.814	0.334	0.086	0.094	0.189	0.995	0.752	0.931	0.984	0.571	1.25	2277.4	0.254	1136.0	7290.1
21.63	2.63	0.537	2.286	6.813	0.334	0.085	0.094	0.188	0.995	0.752	0.931	0.984	0.571	1.25	2277.3	0.254	1134.3	7284.6
21.86	2.64	0.537	2.285	6.811	0.334	0.085	0.094	0.187	0.995	0.752	0.931	0.984	0.570	1.25	2277.2	0.253	1132.7	7279.5
22.09	2.64	0.537	2.284	6.809	0.334	0.085	0.093	0.186	0.995	0.751	0.931	0.984	0.570	1.25	2277.1	0.253	1131.1	7274.3
22.32	2.64	0.537	2.283	6.807	0.334	0.084	0.093	0.185	0.995	0.751	0.931	0.984	0.569	1.25	2277.0	0.253	1129.6	7269.4
22.54	2.64	0.537	2.282	6.805	0.334	0.084	0.092	0.184	0.995	0.751	0.931	0.985	0.569	1.25	2276.8	0.252	1128.1	7264.3
22.77	2.64	0.537	2.282	6.802	0.334	0.084	0.092	0.184	0.995	0.751	0.931	0.985	0.568	1.25	2276.7	0.252	1126.8	7259.6
23.00	2.64	0.537	2.281	6.800	0.334	0.083	0.092	0.183	0.995	0.750	0.931	0.985	0.568	1.25	2276.5	0.252	1125.4	7254.7

23.23	2.64	0.537	2.281	6.797	0.334	0.083	0.091	0.182	0.995	0.750	0.931	0.985	0.567	1.25	2276.4	0.251	1124.0	7249.6
23.45	2.64	0.537	2.281	6.795	0.334	0.083	0.091	0.181	0.995	0.749	0.931	0.985	0.567	1.25	2276.2	0.251	1122.8	7245.0
23.68	2.64	0.537	2.281	6.792	0.334	0.082	0.090	0.180	0.995	0.749	0.931	0.985	0.566	1.25	2276.0	0.251	1121.6	7240.1
23.91	2.64	0.537	2.281	6.789	0.334	0.082	0.090	0.179	0.995	0.749	0.931	0.985	0.566	1.25	2275.8	0.250	1120.4	7235.7
24.14	2.64	0.542	2.281	6.786	0.337	0.082	0.090	0.179	0.995	0.743	0.930	0.986	0.565	1.25	2275.5	0.250	1119.3	7231.0
24.36	2.64	0.542	2.282	6.782	0.337	0.081	0.090	0.178	0.995	0.742	0.930	0.986	0.565	1.25	2275.3	0.249	1118.3	7226.7
24.59	2.64	0.542	2.282	6.779	0.337	0.081	0.090	0.177	0.995	0.742	0.930	0.986	0.564	1.25	2275.1	0.249	1117.3	7222.3
24.82	2.64	0.542	2.283	6.775	0.337	0.081	0.089	0.176	0.995	0.742	0.930	0.986	0.564	1.25	2274.8	0.249	1116.3	7218.2
25.05	2.64	0.542	2.283	6.772	0.337	0.080	0.089	0.176	0.995	0.742	0.930	0.986	0.564	1.25	2274.5	0.248	1115.4	7213.9
25.28	2.64	0.542	2.284	6.768	0.337	0.080	0.088	0.175	0.995	0.742	0.930	0.986	0.563	1.25	2274.3	0.248	1114.6	7210.1
25.50	2.64	0.542	2.285	6.764	0.337	0.080	0.088	0.174	0.995	0.742	0.930	0.986	0.563	1.25	2274.0	0.248	1113.8	7206.0
25.73	2.64	0.542	2.286	6.760	0.337	0.080	0.088	0.173	0.995	0.741	0.930	0.986	0.562	1.25	2273.7	0.247	1113.0	7201.7
25.96	2.64	0.542	2.288	6.755	0.337	0.079	0.087	0.173	0.995	0.741	0.930	0.986	0.562	1.25	2273.3	0.247	1112.2	7197.9
26.19	2.64	0.542	2.289	6.751	0.337	0.079	0.087	0.172	0.995	0.741	0.930	0.987	0.562	1.25	2273.0	0.247	1111.6	7193.9
26.41	2.64	0.542	2.290	6.746	0.337	0.079	0.087	0.171	0.995	0.741	0.929	0.987	0.561	1.25	2272.7	0.246	1111.0	7190.1
26.64	2.64	0.542	2.292	6.742	0.336	0.078	0.086	0.170	0.995	0.741	0.929	0.987	0.561	1.25	2272.3	0.246	1110.5	7186.3
26.87	2.64	0.542	2.294	6.737	0.336	0.078	0.086	0.170	0.995	0.741	0.929	0.987	0.561	1.25	2272.0	0.245	1110.0	7182.4
27.10	2.64	0.542	2.296	6.732	0.336	0.078	0.086	0.169	0.995	0.741	0.929	0.987	0.561	1.25	2271.6	0.245	1109.5	7179.1
27.32	2.64	0.542	2.298	6.727	0.336	0.077	0.085	0.168	0.995	0.741	0.929	0.987	0.560	1.25	2271.2	0.245	1109.1	7175.8
27.55	2.64	0.542	2.300	6.721	0.336	0.077	0.085	0.167	0.995	0.741	0.929	0.987	0.560	1.25	2270.8	0.244	1108.7	7172.3
27.78	2.64	0.542	2.302	6.716	0.336	0.077	0.084	0.167	0.995	0.741	0.929	0.987	0.560	1.25	2270.4	0.244	1108.5	7169.3
28.01	2.64	0.548	2.305	6.710	0.339	0.077	0.085	0.166	0.995	0.735	0.928	0.987	0.560	1.25	2269.9	0.244	1108.2	7165.9
28.24	2.64	0.548	2.307	6.705	0.339	0.076	0.085	0.165	0.995	0.735	0.928	0.988	0.559	1.25	2269.5	0.243	1108.0	7163.0
28.46	2.64	0.548	2.310	6.699	0.339	0.076	0.084	0.165	0.995	0.735	0.928	0.988	0.559	1.25	2269.0	0.243	1107.9	7159.9
28.69	2.64	0.548	2.313	6.693	0.340	0.076	0.084	0.164	0.995	0.735	0.928	0.988	0.559	1.25	2268.6	0.242	1107.8	7157.2
28.92	2.64	0.548	2.316	6.687	0.340	0.075	0.084	0.163	0.995	0.735	0.928	0.988	0.559	1.25	2268.1	0.242	1107.7	7154.3
29.15	2.64	0.548	2.319	6.680	0.340	0.075	0.083	0.163	0.995	0.735	0.928	0.988	0.559	1.25	2267.6	0.242	1107.7	7151.7
29.37	2.64	0.548	2.322	6.674	0.340	0.075	0.083	0.162	0.995	0.735	0.928	0.988	0.558	1.25	2267.1	0.241	1107.8	7149.0
29.60	2.64	0.548	2.325	6.667	0.340	0.075	0.083	0.161	0.995	0.735	0.928	0.988	0.558	1.25	2266.4	0.241	1107.7	7145.2
29.83	2.64	0.548	2.329	6.661	0.340	0.074	0.082	0.161	0.995	0.735	0.929	0.988	0.558	1.25	2265.6	0.240	1107.2	7138.8
30.06	2.64	0.548	2.332	6.654	0.340	0.074	0.082	0.160	0.995	0.735	0.928	0.988	0.558	1.25	2264.6	0.240	1106.8	7132.6
30.29	2.64	0.548	2.336	6.647	0.340	0.074	0.082	0.159	0.995	0.735	0.928	0.988	0.558	1.25	2263.7	0.239	1106.5	7126.9
30.51	2.64	0.548	2.340	6.640	0.340	0.074	0.081	0.158	0.995	0.735	0.928	0.989	0.558	1.25	2262.8	0.239	1106.2	7120.8
30.74	2.64	0.548	2.344	6.633	0.340	0.073	0.081	0.158	0.995	0.736	0.928	0.989	0.558	1.25	2261.8	0.238	1106.0	7115.1
30.97	2.64	0.548	2.348	6.625	0.340	0.073	0.081	0.157	0.995	0.736	0.927	0.989	0.557	1.25	2260.8	0.238	1105.8	7109.6
31.20	2.64	0.548	2.352	6.619	0.340	0.073	0.080	0.156	0.995	0.736	0.927	0.989	0.557	1.25	2259.8	0.238	1105.8	7104.4
31.42	2.64	0.548	2.356	6.610	0.340	0.073	0.080	0.156	0.995	0.736	0.927	0.989	0.557	1.25	2258.8	0.237	1105.7	7098.9
31.65	2.64	0.548	2.361	6.602	0.340	0.072	0.080	0.155	0.995	0.736	0.927	0.989	0.557	1.25	2257.7	0.237	1105.7	7093.7

TETA= 15.0 TIME OF BURNING= 31.65 SEC RANGE OF BURNING=0.2736E+05 KM HEIGHT OF BURNING=0.2286E+04 KM

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RAMJET TRAJECTORY

LPR	WPR	A30	A0/AR	A5/AR	L3	U0	U	WR	TDEV
0.155E+01	0.475E+02	0.530E-02	0.280E+00	0.260E+00	0.584E+00	0.762E+03	0.863E+03	0.199E+01	0.455E+02

TI	X3	Y3	TETA	MO	PO	RHOA	TO	MUA	WPF	DRAG	THRUST
0.228E+00	0.380E+03	0.101E+03	0.149E+02	2.534	0.103E+05	0.122E+01	0.288E+03	0.179E-04	47.5	1381.3	1370.6
0.114E+01	0.114E+04	0.297E+03	0.143E+02	2.533	0.101E+05	0.120E+01	0.287E+03	0.178E-04	47.3	1353.0	1378.4
0.205E+01	0.190E+04	0.486E+03	0.137E+02	2.534	0.988E+04	0.119E+01	0.286E+03	0.177E-04	47.2	1328.9	1381.3
0.296E+01	0.266E+04	0.666E+03	0.131E+02	2.536	0.968E+04	0.117E+01	0.284E+03	0.177E-04	47.0	1306.0	1378.6
0.387E+01	0.342E+04	0.839E+03	0.125E+02	2.540	0.948E+04	0.115E+01	0.283E+03	0.176E-04	46.9	1284.4	1372.3
0.478E+01	0.418E+04	0.100E+04	0.120E+02	2.544	0.930E+04	0.113E+01	0.282E+03	0.175E-04	46.7	1264.3	1363.0
0.569E+01	0.495E+04	0.116E+04	0.114E+02	2.549	0.912E+04	0.112E+01	0.281E+03	0.175E-04	46.6	1245.5	1351.8
0.660E+01	0.572E+04	0.131E+04	0.108E+02	2.555	0.895E+04	0.110E+01	0.280E+03	0.174E-04	46.4	1228.1	1338.5
0.751E+01	0.649E+04	0.145E+04	0.102E+02	2.560	0.880E+04	0.108E+01	0.279E+03	0.174E-04	46.3	1211.8	1323.1
0.843E+01	0.726E+04	0.158E+04	0.962E+01	2.566	0.865E+04	0.107E+01	0.278E+03	0.173E-04	46.2	1196.6	1307.4
0.934E+01	0.803E+04	0.171E+04	0.903E+01	2.572	0.851E+04	0.106E+01	0.278E+03	0.173E-04	46.1	1182.6	1291.7
0.102E+02	0.880E+04	0.183E+04	0.845E+01	2.578	0.838E+04	0.104E+01	0.277E+03	0.173E-04	46.0	1169.5	1276.3
0.112E+02	0.958E+04	0.194E+04	0.786E+01	2.584	0.826E+04	0.103E+01	0.276E+03	0.172E-04	45.8	1157.5	1261.1
0.121E+02	0.104E+05	0.204E+04	0.727E+01	2.590	0.816E+04	0.102E+01	0.275E+03	0.172E-04	45.7	1146.5	1246.5
0.130E+02	0.111E+05	0.214E+04	0.668E+01	2.595	0.806E+04	0.101E+01	0.275E+03	0.172E-04	45.6	1136.5	1232.3
0.139E+02	0.119E+05	0.222E+04	0.609E+01	2.600	0.796E+04	0.100E+01	0.274E+03	0.171E-04	45.5	1127.5	1218.9
0.148E+02	0.127E+05	0.230E+04	0.549E+01	2.605	0.788E+04	0.992E+00	0.273E+03	0.171E-04	45.4	1119.5	1206.1
0.157E+02	0.135E+05	0.237E+04	0.490E+01	2.610	0.781E+04	0.984E+00	0.273E+03	0.171E-04	45.3	1112.5	1194.0
0.166E+02	0.143E+05	0.243E+04	0.431E+01	2.615	0.774E+04	0.977E+00	0.273E+03	0.171E-04	45.2	1106.4	1182.6
0.175E+02	0.151E+05	0.249E+04	0.372E+01	2.619	0.769E+04	0.971E+00	0.272E+03	0.170E-04	45.1	1101.3	1172.1
0.184E+02	0.159E+05	0.253E+04	0.313E+01	2.623	0.764E+04	0.966E+00	0.272E+03	0.170E-04	45.0	1097.1	1162.2
0.194E+02	0.166E+05	0.257E+04	0.253E+01	2.627	0.760E+04	0.962E+00	0.272E+03	0.170E-04	44.9	1093.8	1153.2
0.203E+02	0.174E+05	0.260E+04	0.194E+01	2.630	0.757E+04	0.959E+00	0.271E+03	0.170E-04	44.8	1091.4	1145.1
0.212E+02	0.182E+05	0.262E+04	0.135E+01	2.633	0.754E+04	0.956E+00	0.271E+03	0.170E-04	44.7	1089.9	1137.7
0.221E+02	0.190E+05	0.264E+04	0.763E+00	2.636	0.753E+04	0.955E+00	0.271E+03	0.170E-04	44.6	1089.4	1131.1
0.230E+02	0.198E+05	0.264E+04	0.172E+00	2.638	0.752E+04	0.954E+00	0.271E+03	0.170E-04	44.5	1089.7	1125.4
0.239E+02	0.206E+05	0.264E+04	-0.419E+00	2.640	0.752E+04	0.954E+00	0.271E+03	0.170E-04	44.4	1091.0	1120.4
0.248E+02	0.214E+05	0.263E+04	-0.101E+01	2.641	0.753E+04	0.955E+00	0.271E+03	0.170E-04	44.3	1093.1	1116.3
0.257E+02	0.222E+05	0.261E+04	-0.160E+01	2.643	0.755E+04	0.957E+00	0.271E+03	0.170E-04	44.2	1096.2	1113.0
0.266E+02	0.230E+05	0.258E+04	-0.219E+01	2.643	0.757E+04	0.959E+00	0.271E+03	0.170E-04	44.0	1100.2	1110.5
0.276E+02	0.238E+05	0.255E+04	-0.278E+01	2.644	0.761E+04	0.963E+00	0.272E+03	0.170E-04	43.9	1105.1	1108.7
0.285E+02	0.246E+05	0.250E+04	-0.337E+01	2.644	0.765E+04	0.967E+00	0.272E+03	0.170E-04	43.8	1110.9	1107.9
0.294E+02	0.254E+05	0.245E+04	-0.396E+01	2.644	0.770E+04	0.972E+00	0.272E+03	0.171E-04	43.7	1117.6	1107.8
0.303E+02	0.262E+05	0.239E+04	-0.454E+01	2.643	0.776E+04	0.979E+00	0.273E+03	0.171E-04	43.6	1125.2	1106.5
0.312E+02	0.270E+05	0.232E+04	-0.513E+01	2.641	0.782E+04	0.985E+00	0.273E+03	0.171E-04	43.5	1133.6	1105.8
0.321E+02	0.278E+05	0.225E+04	-0.572E+01	2.622	0.790E+04	0.993E+00	0.274E+03	0.171E-04	43.4	1131.8	0.0
0.330E+02	0.285E+05	0.216E+04	-0.632E+01	2.551	0.798E+04	0.100E+01	0.274E+03	0.171E-04	43.4	1099.5	0.0
0.339E+02	0.293E+05	0.208E+04	-0.693E+01	2.483	0.807E+04	0.101E+01	0.275E+03	0.172E-04	43.4	1069.1	0.0
0.348E+02	0.300E+05	0.198E+04	-0.757E+01	2.417	0.817E+04	0.102E+01	0.275E+03	0.172E-04	43.4	1040.8	0.0
0.357E+02	0.307E+05	0.188E+04	-0.821E+01	2.352	0.827E+04	0.103E+01	0.276E+03	0.172E-04	43.4	1014.2	0.0
0.367E+02	0.314E+05	0.178E+04	-0.887E+01	2.290	0.838E+04	0.104E+01	0.277E+03	0.173E-04	43.4	989.1	0.0
0.376E+02	0.321E+05	0.167E+04	-0.955E+01	2.230	0.849E+04	0.105E+01	0.277E+03	0.173E-04	43.4	964.1	0.0
0.385E+02	0.327E+05	0.155E+04	-0.102E+02	2.171	0.862E+04	0.107E+01	0.278E+03	0.173E-04	43.4	942.3	0.0
0.394E+02	0.334E+05	0.143E+04	-0.110E+02	2.113	0.874E+04	0.108E+01	0.279E+03	0.174E-04	43.4	922.7	0.0
0.403E+02	0.340E+05	0.131E+04	-0.117E+02	2.056	0.888E+04	0.109E+01	0.280E+03	0.174E-04	43.4	902.3	0.0
0.412E+02	0.346E+05	0.119E+04	-0.125E+02	2.000	0.902E+04	0.111E+01	0.281E+03	0.175E-04	43.4	882.8	0.0
0.421E+02	0.352E+05	0.105E+04	-0.132E+02	1.946	0.917E+04	0.112E+01	0.281E+03	0.175E-04	43.4	869.5	0.0
0.430E+02	0.357E+05	0.907E+03	-0.140E+02	1.893	0.932E+04	0.113E+01	0.282E+03	0.176E-04	43.4	856.1	0.0
0.439E+02	0.363E+05	0.765E+03	-0.148E+02	1.842	0.948E+04	0.115E+01	0.283E+03	0.176E-04	43.4	842.6	0.0
0.449E+02	0.368E+05	0.618E+03	-0.157E+02	1.791	0.964E+04	0.116E+01	0.284E+03	0.177E-04	43.4	829.2	0.0
0.458E+02	0.373E+05	0.468E+03	-0.165E+02	1.742	0.980E+04	0.118E+01	0.285E+03	0.177E-04	43.4	813.3	0.0
0.467E+02	0.378E+05	0.314E+03	-0.174E+02	1.695	0.997E+04	0.119E+01	0.286E+03	0.178E-04	43.4	798.7	0.0
0.476E+02	0.383E+05	0.156E+03	-0.183E+02	1.649	0.101E+05	0.121E+01	0.287E+03	0.178E-04	43.4	783.1	0.0
0.485E+02	0.388E+05	-0.515E+01	-0.192E+02	1.605	0.103E+05	0.122E+01	0.288E+03	0.179E-04	43.4	766.7	0.0

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RAMJET TRAJECTORY

(DRAG COEF.)

LPR	WPR	A30	A0/AR	A5/AR	L3	U0	U	WR	TDEV
0.155E+01	0.475E+02	0.530E-02	0.280E+03	0.260E+03	0.584E+00	0.762E+03	0.863E+03	0.199E+01	0.455E+02

TETP	CDN	CDS	CDWW	CDWF	APR	SPP	SWW	Q	XMO
9.50	0.864E-01	0.210E-02	0.974E-02	0.346E-02	0.127E-01	0.618E+00	0.484E-01	0.456E+06	1.40
9.50	0.864E-01	0.210E-02	0.974E-02	0.347E-02	0.127E-01	0.618E+00	0.484E-01	0.446E+06	1.40
9.50	0.863E-01	0.211E-02	0.974E-02	0.348E-02	0.127E-01	0.618E+00	0.484E-01	0.438E+06	1.40
9.50	0.863E-01	0.211E-02	0.973E-02	0.349E-02	0.127E-01	0.618E+00	0.484E-01	0.430E+06	1.40
9.50	0.862E-01	0.211E-02	0.972E-02	0.349E-02	0.127E-01	0.618E+00	0.484E-01	0.423E+06	1.40
9.50	0.860E-01	0.212E-02	0.970E-02	0.350E-02	0.127E-01	0.618E+00	0.484E-01	0.416E+06	1.40
9.50	0.858E-01	0.212E-02	0.969E-02	0.351E-02	0.127E-01	0.618E+00	0.484E-01	0.410E+06	1.40
9.50	0.856E-01	0.212E-02	0.966E-02	0.352E-02	0.127E-01	0.618E+00	0.484E-01	0.405E+06	1.40
9.50	0.854E-01	0.213E-02	0.964E-02	0.352E-02	0.127E-01	0.618E+00	0.484E-01	0.399E+06	1.40
9.50	0.852E-01	0.213E-02	0.962E-02	0.353E-02	0.127E-01	0.618E+00	0.484E-01	0.395E+06	1.40
9.50	0.850E-01	0.213E-02	0.960E-02	0.353E-02	0.127E-01	0.618E+00	0.484E-01	0.390E+06	1.40
9.50	0.848E-01	0.214E-02	0.958E-02	0.354E-02	0.127E-01	0.618E+00	0.484E-01	0.386E+06	1.40
9.50	0.846E-01	0.214E-02	0.956E-02	0.354E-02	0.127E-01	0.619E+00	0.484E-01	0.382E+06	1.40
9.50	0.845E-01	0.214E-02	0.954E-02	0.355E-02	0.127E-01	0.618E+00	0.484E-01	0.379E+06	1.40
9.50	0.843E-01	0.214E-02	0.952E-02	0.355E-02	0.127E-01	0.618E+00	0.484E-01	0.376E+06	1.40
9.50	0.841E-01	0.215E-02	0.950E-02	0.356E-02	0.127E-01	0.618E+00	0.484E-01	0.373E+06	1.40
9.50	0.839E-01	0.215E-02	0.948E-02	0.356E-02	0.127E-01	0.618E+00	0.484E-01	0.371E+06	1.40
9.50	0.838E-01	0.215E-02	0.946E-02	0.357E-02	0.127E-01	0.618E+00	0.484E-01	0.368E+06	1.40
9.50	0.837E-01	0.215E-02	0.945E-02	0.357E-02	0.127E-01	0.618E+00	0.484E-01	0.367E+06	1.40
9.50	0.835E-01	0.215E-02	0.943E-02	0.357E-02	0.127E-01	0.618E+00	0.484E-01	0.365E+06	1.40
9.50	0.834E-01	0.215E-02	0.942E-02	0.357E-02	0.127E-01	0.618E+00	0.484E-01	0.364E+06	1.40
9.50	0.833E-01	0.215E-02	0.941E-02	0.358E-02	0.127E-01	0.618E+00	0.484E-01	0.363E+06	1.40
9.50	0.832E-01	0.215E-02	0.940E-02	0.358E-02	0.127E-01	0.618E+00	0.484E-01	0.362E+06	1.40
9.50	0.831E-01	0.216E-02	0.939E-02	0.358E-02	0.127E-01	0.618E+00	0.484E-01	0.362E+06	1.40
9.50	0.830E-01	0.216E-02	0.938E-02	0.358E-02	0.127E-01	0.618E+00	0.484E-01	0.362E+06	1.40
9.50	0.830E-01	0.216E-02	0.937E-02	0.358E-02	0.127E-01	0.618E+00	0.484E-01	0.362E+06	1.40
9.50	0.829E-01	0.215E-02	0.936E-02	0.358E-02	0.127E-01	0.618E+00	0.484E-01	0.363E+06	1.40
9.50	0.829E-01	0.215E-02	0.936E-02	0.358E-02	0.127E-01	0.618E+00	0.484E-01	0.364E+06	1.40
9.50	0.828E-01	0.215E-02	0.935E-02	0.357E-02	0.127E-01	0.618E+00	0.484E-01	0.365E+06	1.40
9.50	0.828E-01	0.215E-02	0.935E-02	0.357E-02	0.127E-01	0.618E+00	0.484E-01	0.366E+06	1.40
9.50	0.828E-01	0.215E-02	0.935E-02	0.357E-02	0.127E-01	0.618E+00	0.484E-01	0.368E+06	1.40
9.50	0.828E-01	0.215E-02	0.935E-02	0.357E-02	0.127E-01	0.618E+00	0.484E-01	0.370E+06	1.40
9.50	0.828E-01	0.215E-02	0.935E-02	0.357E-02	0.127E-01	0.618E+00	0.484E-01	0.372E+06	1.40
9.50	0.828E-01	0.215E-02	0.935E-02	0.356E-02	0.127E-01	0.618E+00	0.484E-01	0.375E+06	1.40
9.50	0.829E-01	0.215E-02	0.936E-02	0.356E-02	0.127E-01	0.618E+00	0.484E-01	0.374E+06	1.40
9.50	0.834E-01	0.215E-02	0.942E-02	0.356E-02	0.127E-01	0.618E+00	0.484E-01	0.376E+06	1.40
9.50	0.858E-01	0.215E-02	0.968E-02	0.357E-02	0.127E-01	0.618E+00	0.484E-01	0.360E+06	1.40
9.50	0.881E-01	0.216E-02	0.994E-02	0.358E-02	0.127E-01	0.618E+00	0.484E-01	0.345E+06	1.40
9.50	0.906E-01	0.216E-02	0.102E-01	0.359E-02	0.127E-01	0.618E+00	0.484E-01	0.330E+06	1.40
9.50	0.931E-01	0.217E-02	0.105E-01	0.360E-02	0.127E-01	0.618E+00	0.484E-01	0.317E+06	1.40
9.50	0.957E-01	0.217E-02	0.108E-01	0.361E-02	0.127E-01	0.618E+00	0.484E-01	0.304E+06	1.40
9.50	0.979E-01	0.218E-02	0.110E-01	0.363E-02	0.127E-01	0.618E+00	0.484E-01	0.293E+06	1.40
9.50	0.101E+00	0.218E-02	0.113E-01	0.364E-02	0.127E-01	0.618E+00	0.484E-01	0.281E+06	1.40
9.50	0.104E+00	0.219E-02	0.116E-01	0.365E-02	0.127E-01	0.618E+00	0.484E-01	0.271E+06	1.40
9.50	0.107E+00	0.219E-02	0.120E-01	0.366E-02	0.127E-01	0.618E+00	0.484E-01	0.260E+06	1.40
9.50	0.111E+00	0.220E-02	0.123E-01	0.367E-02	0.127E-01	0.618E+00	0.484E-01	0.250E+06	1.40
9.50	0.116E+00	0.220E-02	0.127E-01	0.368E-02	0.127E-01	0.618E+00	0.484E-01	0.240E+06	1.40
9.50	0.121E+00	0.221E-02	0.130E-01	0.369E-02	0.127E-01	0.618E+00	0.484E-01	0.231E+06	1.40
9.50	0.126E+00	0.221E-02	0.134E-01	0.370E-02	0.127E-01	0.618E+00	0.484E-01	0.222E+06	1.40
9.50	0.131E+00	0.222E-02	0.138E-01	0.371E-02	0.127E-01	0.618E+00	0.484E-01	0.213E+06	1.40
9.50	0.136E+00	0.222E-02	0.142E-01	0.372E-02	0.127E-01	0.618E+00	0.484E-01	0.205E+06	1.40
9.50	0.140E+00	0.223E-02	0.146E-01	0.373E-02	0.127E-01	0.618E+00	0.484E-01	0.198E+06	1.40
9.50	0.145E+00	0.223E-02	0.151E-01	0.374E-02	0.127E-01	0.618E+00	0.484E-01	0.190E+06	1.40

9.50	0.149E+00	0.224E-02	0.155E-01	0.376E-02	0.127E-01	0.618E+00	0.484E-01	0.182E+06	1.40

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CCC                       CCC
CCC   SOLID FUEL RAMJET   CCC
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GEOMETRICAL DATA:

AREF= 0.1245E-01M2 L3= 0.5842E+00M TETP= 9.5

AO/AREF	A1C/AO	A1/AO	A2/AO	A3/AREF	A5/AREF	A6/A5
0.2800	0.8194	0.4200	0.8269	0.4259	0.2600	3.8462

MO	M1C	M6
2.5336	2.3136	2.6646

CONSTANT LOSSES:

PID1= 0.930 PID2= 0.930 PIN= 0.960

INITIAL FLIGHT CONDITIONS:

PO(KG/M2)	TO(K)	ROO(KG/M3)	PTO(KG/M2)	TTO(K)	GA
0.103E+05	0.288E+03	0.122E+01	0.186E+06	0.658E+03	1.400

TIME	MO	AS/AO	WA	WF/WA	M2	M3N	M31	M6	TOTAL PRES. RATIOS 1C/0	12/11	3/2	4/3	6/0	GF	TT4(K)	CF	F(N)	ISP
0.62	2.53	0.509	2.929	6.596	0.329	0.163	0.180	0.391	0.996	0.838	0.949	0.940	0.620	1.25	2258.8	0.242	1370.6	7094.8
1.24	2.54	0.509	2.929	6.570	0.329	0.158	0.173	0.373	0.996	0.838	0.948	0.944	0.619	1.25	2255.0	0.241	1363.8	7087.8
1.87	2.54	0.496	2.760	6.703	0.321	0.151	0.163	0.357	0.996	0.849	0.948	0.948	0.628	1.25	2268.3	0.263	1383.5	7477.9
2.49	2.55	0.496	2.666	6.776	0.321	0.146	0.158	0.345	0.996	0.848	0.947	0.951	0.634	1.25	2272.4	0.274	1379.6	7637.0
3.11	2.55	0.490	2.571	6.854	0.318	0.141	0.152	0.333	0.996	0.853	0.948	0.954	0.637	1.25	2277.5	0.283	1365.0	7744.5
3.73	2.56	0.490	2.477	6.939	0.317	0.137	0.148	0.324	0.996	0.850	0.947	0.956	0.638	1.25	2283.4	0.290	1343.6	7816.2
4.35	2.57	0.490	2.385	7.028	0.316	0.133	0.144	0.315	0.996	0.846	0.947	0.958	0.637	1.25	2290.0	0.297	1317.6	7860.9
4.98	2.58	0.484	2.294	7.123	0.312	0.130	0.139	0.307	0.996	0.849	0.947	0.959	0.635	1.25	2297.2	0.302	1289.3	7884.6
5.60	2.59	0.484	2.205	7.221	0.311	0.126	0.136	0.300	0.996	0.844	0.947	0.961	0.633	1.25	2305.0	0.306	1256.8	7891.6
6.22	2.60	0.484	2.119	7.323	0.310	0.124	0.133	0.294	0.996	0.838	0.947	0.962	0.629	1.25	2312.0	0.310	1222.6	7877.1
6.84	2.61	0.490	2.036	7.430	0.313	0.121	0.131	0.289	0.996	0.825	0.946	0.963	0.624	1.25	2315.1	0.312	1183.2	7822.6
7.47	2.62	0.490	1.955	7.540	0.312	0.119	0.129	0.284	0.996	0.819	0.946	0.964	0.619	1.25	2318.5	0.314	1143.7	7759.9
8.09	2.63	0.490	1.877	7.653	0.311	0.117	0.127	0.280	0.995	0.813	0.946	0.965	0.613	1.25	2322.0	0.316	1104.7	7692.6
8.71	2.64	0.490	1.801	7.769	0.310	0.115	0.125	0.276	0.995	0.807	0.946	0.966	0.607	1.25	2322.2	0.316	1063.3	7599.2
9.33	2.65	0.496	1.728	7.889	0.312	0.113	0.124	0.272	0.995	0.793	0.945	0.967	0.601	1.25	2320.1	0.315	1020.9	7487.1
9.95	2.66	0.496	1.658	8.012	0.311	0.111	0.122	0.269	0.995	0.788	0.945	0.969	0.595	1.25	2317.8	0.315	979.6	7373.9
10.58	2.67	0.496	1.591	8.139	0.310	0.110	0.121	0.266	0.995	0.782	0.945	0.968	0.589	1.25	2315.5	0.315	939.9	7261.1
11.20	2.68	0.503	1.526	8.267	0.313	0.108	0.121	0.263	0.995	0.769	0.944	0.969	0.583	1.25	2313.0	0.314	901.7	7149.0
11.82	2.69	0.503	1.464	8.398	0.312	0.107	0.119	0.261	0.995	0.764	0.944	0.969	0.577	1.25	2305.2	0.312	857.4	6992.1
12.44	2.70	0.509	1.404	8.533	0.314	0.106	0.119	0.258	0.995	0.752	0.943	0.970	0.571	1.25	2295.3	0.309	817.1	6821.7
13.06	2.71	0.509	1.347	8.670	0.314	0.105	0.118	0.256	0.995	0.746	0.943	0.970	0.563	1.25	2285.4	0.305	775.8	6644.8
13.69	2.72	0.515	1.292	8.809	0.316	0.104	0.118	0.254	0.995	0.734	0.942	0.970	0.557	1.26	2275.1	0.302	736.6	6473.6
14.31	2.73	0.515	1.239	8.951	0.316	0.103	0.117	0.253	0.995	0.730	0.942	0.971	0.551	1.26	2264.6	0.299	699.7	6308.2
14.93	2.73	0.522	1.189	9.096	0.318	0.103	0.118	0.251	0.995	0.719	0.941	0.971	0.545	1.26	2253.7	0.295	664.8	6148.2
15.55	2.74	0.522	1.141	9.243	0.318	0.102	0.117	0.250	0.994	0.715	0.941	0.971	0.540	1.26	2240.2	0.291	633.6	6030.3
16.17	2.75	0.522	1.095	9.392	0.317	0.101	0.116	0.248	0.994	0.711	0.941	0.971	0.535	1.26	2226.4	0.291	602.1	5856.7
16.80	2.75	0.528	1.051	9.543	0.320	0.100	0.117	0.247	0.994	0.701	0.940	0.972	0.531	1.26	2212.2	0.288	573.2	5716.6
17.42	2.76	0.528	1.009	9.697	0.320	0.100	0.116	0.246	0.994	0.698	0.942	0.972	0.527	1.26	2197.8	0.286	545.7	5579.7
18.04	2.76	0.528	0.968	9.852	0.320	0.099	0.116	0.245	0.994	0.695	0.940	0.972	0.523	1.26	2183.2	0.284	519.6	5445.9

18.66	2.77	0.534	0.93010.009	0.323	0.099	0.117	0.244	0.994	0.686	0.939	0.972	0.519	1.26	2168.2	0.282	494.7	5314.0
19.29	2.77	0.534	0.89410.168	0.322	0.098	0.116	0.244	0.994	0.683	0.939	0.972	0.516	1.26	2151.6	0.279	469.6	5168.6
19.91	2.78	0.534	0.85910.329	0.322	0.098	0.116	0.243	0.994	0.681	0.939	0.972	0.512	1.26	2134.7	0.275	445.8	5026.8
20.53	2.78	0.541	0.82510.492	0.325	0.097	0.117	0.242	0.994	0.673	0.938	0.972	0.509	1.26	2117.7	0.273	423.3	4989.1
21.15	2.77	0.541	0.79310.656	0.325	0.097	0.116	0.242	0.994	0.673	0.938	0.972	0.509	1.27	2100.8	0.272	404.2	4781.6
21.77	2.76	0.534	0.76310.822	0.322	0.097	0.115	0.241	0.994	0.683	0.939	0.972	0.515	1.27	2084.5	0.276	390.7	4731.8
22.40	2.75	0.534	0.73410.989	0.323	0.097	0.115	0.241	0.994	0.687	0.939	0.973	0.521	1.27	2068.1	0.280	377.6	4691.0
23.02	2.75	0.528	0.70611.157	0.320	0.096	0.114	0.240	0.994	0.698	0.940	0.973	0.527	1.27	2051.9	0.284	365.0	4631.3
23.64	2.74	0.528	0.68011.327	0.321	0.096	0.114	0.240	0.994	0.702	0.940	0.973	0.533	1.27	2036.2	0.288	353.2	4596.3
24.26	2.73	0.522	0.65511.498	0.318	0.096	0.113	0.239	0.994	0.713	0.941	0.973	0.539	1.27	2020.4	0.292	341.8	4539.5
24.88	2.72	0.519	0.63111.670	0.317	0.096	0.112	0.239	0.995	0.720	0.941	0.973	0.545	1.27	2004.6	0.296	330.6	4490.7
25.51	2.72	0.515	0.60811.843	0.315	0.096	0.112	0.239	0.995	0.728	0.942	0.973	0.551	1.27	1988.7	0.300	319.7	4440.6
26.13	2.71	0.512	0.58612.016	0.314	0.096	0.111	0.239	0.995	0.735	0.942	0.973	0.557	1.28	1972.8	0.303	309.1	4389.0
26.75	2.70	0.509	0.56512.191	0.313	0.095	0.111	0.238	0.995	0.743	0.942	0.973	0.563	1.28	1956.8	0.307	298.8	4336.4
27.37	2.69	0.509	0.54512.367	0.314	0.095	0.111	0.238	0.995	0.747	0.942	0.973	0.568	1.28	1940.7	0.310	288.8	4282.9
27.99	2.69	0.503	0.52612.542	0.311	0.095	0.110	0.238	0.995	0.758	0.943	0.973	0.574	1.28	1924.6	0.313	279.1	4228.6
28.62	2.68	0.503	0.50812.720	0.312	0.095	0.110	0.238	0.995	0.762	0.943	0.973	0.580	1.28	1909.3	0.317	270.1	4179.9
29.24	2.67	0.496	0.49112.898	0.309	0.095	0.109	0.238	0.995	0.773	0.944	0.973	0.587	1.28	1895.6	0.321	262.2	4142.4
29.86	2.66	0.493	0.47413.075	0.308	0.095	0.109	0.238	0.995	0.781	0.944	0.973	0.593	1.28	1881.9	0.325	254.4	4104.2
30.48	2.66	0.490	0.45813.254	0.307	0.095	0.108	0.238	0.995	0.789	0.945	0.973	0.599	1.28	1868.1	0.329	247.0	4065.2
31.11	2.65	0.487	0.44313.432	0.306	0.095	0.108	0.238	0.995	0.797	0.945	0.973	0.606	1.28	1854.4	0.333	239.7	4025.7
31.73	2.64	0.484	0.42913.611	0.305	0.095	0.107	0.238	0.995	0.805	0.945	0.973	0.612	1.28	1840.7	0.337	232.7	3985.7
32.35	2.63	0.477	0.41513.789	0.302	0.095	0.106	0.238	0.995	0.816	0.946	0.973	0.618	1.29	1827.1	0.341	225.4	3945.1
32.97	2.63	0.477	0.40213.968	0.303	0.095	0.107	0.238	0.995	0.820	0.946	0.973	0.624	1.29	1813.4	0.344	219.2	3904.6
33.59	2.62	0.471	0.38914.146	0.300	0.095	0.106	0.239	0.995	0.832	0.947	0.973	0.630	1.29	1799.9	0.348	212.9	3863.8
34.22	2.61	0.471	0.37714.325	0.301	0.095	0.106	0.238	0.995	0.836	0.947	0.973	0.636	1.29	1786.3	0.351	206.7	3822.9
34.84	2.61	0.468	0.36614.503	0.300	0.095	0.106	0.238	0.995	0.843	0.947	0.973	0.642	1.29	1772.9	0.354	200.7	3781.9
35.46	2.60	0.465	0.35514.680	0.299	0.095	0.105	0.238	0.996	0.851	0.947	0.973	0.648	1.29	1759.4	0.357	195.0	3740.9
36.08	2.59	0.465	0.34514.857	0.299	0.095	0.106	0.238	0.996	0.855	0.947	0.972	0.654	1.29	1746.0	0.361	189.4	3700.1
36.70	2.59	0.458	0.33515.033	0.297	0.095	0.105	0.238	0.996	0.866	0.948	0.972	0.660	1.29	1732.7	0.363	184.1	3659.6
37.33	2.58	0.458	0.32515.209	0.297	0.095	0.105	0.238	0.996	0.871	0.948	0.972	0.665	1.29	1719.5	0.366	178.9	3619.2
37.95	2.57	0.452	0.31615.393	0.295	0.095	0.104	0.238	0.996	0.882	0.949	0.972	0.671	1.29	1706.4	0.369	173.9	3579.0
38.57	2.57	0.452	0.30715.557	0.296	0.095	0.104	0.238	0.996	0.885	0.948	0.972	0.676	1.29	1693.3	0.372	169.1	3539.2
39.19	2.56	0.445	0.29915.729	0.293	0.095	0.104	0.238	0.996	0.897	0.949	0.972	0.682	1.29	1680.4	0.374	164.5	3499.7
39.81	2.56	0.445	0.29115.901	0.294	0.095	0.104	0.239	0.996	0.900	0.949	0.972	0.687	1.29	1667.6	0.376	160.0	3460.6
40.44	2.55	0.445	0.28316.071	0.295	0.095	0.104	0.238	0.996	0.903	0.949	0.972	0.692	1.30	1654.9	0.379	155.8	3422.1
41.06	2.54	0.439	0.27616.239	0.292	0.095	0.103	0.238	0.996	0.915	0.949	0.972	0.698	1.30	1642.3	0.381	151.6	3384.0
41.68	2.54	0.439	0.26916.407	0.293	0.095	0.103	0.238	0.996	0.918	0.949	0.972	0.703	1.30	1629.9	0.383	147.7	3346.3
42.30	2.53	0.433	0.26216.572	0.291	0.095	0.103	0.238	0.996	0.929	0.950	0.972	0.708	1.30	1617.6	0.385	143.9	3309.3
42.93	2.53	0.433	0.25616.736	0.292	0.095	0.103	0.239	0.996	0.932	0.950	0.972	0.713	1.30	1605.4	0.387	140.2	3272.7
43.55	2.52	0.426	0.25016.898	0.290	0.095	0.102	0.238	0.996	0.943	0.950	0.972	0.718	1.30	1593.4	0.389	136.7	3236.8
44.17	2.52	0.426	0.24417.057	0.290	0.095	0.103	0.238	0.996	0.945	0.950	0.972	0.722	1.30	1581.6	0.391	133.3	3201.5
44.79	2.51	0.426	0.23917.215	0.291	0.095	0.103	0.239	0.996	0.948	0.950	0.972	0.727	1.30	1569.9	0.392	130.0	3166.7
45.41	2.51	0.423	0.23317.371	0.290	0.095	0.103	0.238	0.996	0.954	0.950	0.972	0.732	1.30	1558.4	0.394	126.9	3132.6

TETA= 45.0 TIME OF BURNING= 45.41 SEC RANGE OF BURNING=0.3080E+05 KM HEIGHT OF BURNING=0.2007E+05 KM

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RAMJET TRAJECTORY

LPR	WPR	A30	AO/AR	A5/AP	L3	UO	U	WR	TREV
0.155E+01	0.475E+02	0.530E-02	0.780E+00	0.260E+00	0.584E+00	0.762E+03	0.863E+03	0.199E+01	0.124E+03

TI	X3	Y3	TETA	MO	PO	RHOA	TO	MUA	WPR	DRAG	THRUST
0.622E+00	0.759E+03	0.755E+03	0.447E+02	2.534	0.103E+05	0.122E+01	0.288E+03	0.179E-04	47.5	1381.3	1370.6
0.311E+01	0.228E+04	0.223E+04	0.435E+02	2.552	0.832E+04	0.104E+01	0.275E+03	0.172E-04	47.0	1143.9	1365.0
0.560E+01	0.383E+04	0.366E+04	0.423E+02	2.587	0.689E+04	0.886E+00	0.267E+03	0.168E-04	46.7	973.3	1256.9
0.809E+01	0.541E+04	0.506E+04	0.411E+02	2.630	0.559E+04	0.753E+00	0.257E+03	0.164E-04	46.5	826.8	1104.7
0.106E+02	0.701E+04	0.642E+04	0.398E+02	2.672	0.470E+04	0.638E+00	0.248E+03	0.160E-04	46.3	700.1	939.9
0.131E+02	0.864E+04	0.774E+04	0.386E+02	2.710	0.389E+04	0.540E+00	0.240E+03	0.157E-04	46.1	564.3	775.8
0.156E+02	0.103E+05	0.901E+04	0.372E+02	2.742	0.323E+04	0.458E+00	0.231E+03	0.153E-04	46.0	475.8	632.6
0.180E+02	0.120E+05	0.102E+05	0.359E+02	2.765	0.269E+04	0.389E+00	0.224E+03	0.150E-04	45.9	401.0	519.6
0.205E+02	0.136E+05	0.114E+05	0.345E+02	2.778	0.225E+04	0.332E+00	0.217E+03	0.141E-04	45.9	337.4	423.3
0.230E+02	0.153E+05	0.125E+05	0.331E+02	2.746	0.190E+04	0.284E+00	0.217E+03	0.141E-04	45.9	288.3	365.0
0.255E+02	0.170E+05	0.136E+05	0.316E+02	2.715	0.162E+04	0.245E+00	0.217E+03	0.141E-04	45.8	247.7	319.7
0.280E+02	0.187E+05	0.146E+05	0.301E+02	2.685	0.138E+04	0.212E+00	0.217E+03	0.141E-04	45.8	214.0	275.1
0.305E+02	0.204E+05	0.156E+05	0.286E+02	2.656	0.119E+04	0.185E+00	0.217E+03	0.141E-04	45.8	186.1	247.0
0.330E+02	0.221E+05	0.165E+05	0.270E+02	2.628	0.104E+04	0.163E+00	0.217E+03	0.141E-04	45.8	163.0	219.2
0.355E+02	0.239E+05	0.173E+05	0.253E+02	2.601	0.909E+03	0.144E+00	0.217E+03	0.141E-04	45.8	143.7	195.0
0.379E+02	0.256E+05	0.181E+05	0.237E+02	2.575	0.803E+03	0.128E+00	0.217E+03	0.141E-04	45.8	127.7	173.9
0.404E+02	0.273E+05	0.188E+05	0.220E+02	2.550	0.716E+03	0.115E+00	0.217E+03	0.141E-04	45.8	114.4	155.8
0.429E+02	0.291E+05	0.195E+05	0.202E+02	2.527	0.644E+03	0.105E+00	0.217E+03	0.141E-04	45.9	101.2	140.2
0.454E+02	0.308E+05	0.201E+05	0.185E+02	2.506	0.584E+03	0.954E-01	0.217E+03	0.141E-04	45.8	93.9	126.9
0.479E+02	0.325E+05	0.206E+05	0.166E+02	2.469	0.535E+03	0.879E-01	0.217E+03	0.141E-04	45.9	85.4	0.0
0.504E+02	0.343E+05	0.211E+05	0.148E+02	2.431	0.495E+03	0.817E-01	0.217E+03	0.141E-04	45.8	78.2	0.0
0.529E+02	0.360E+05	0.215E+05	0.129E+02	2.396	0.462E+03	0.765E-01	0.217E+03	0.141E-04	45.8	72.3	0.0
0.554E+02	0.377E+05	0.219E+05	0.109E+02	2.364	0.436E+03	0.725E-01	0.217E+03	0.141E-04	45.8	67.5	0.0
0.579E+02	0.394E+05	0.221E+05	0.894E+01	2.336	0.416E+03	0.693E-01	0.217E+03	0.141E-04	45.8	63.7	0.0
0.603E+02	0.411E+05	0.224E+05	0.692E+01	2.311	0.400E+03	0.668E-01	0.217E+03	0.141E-04	45.8	60.3	0.0
0.628E+02	0.428E+05	0.225E+05	0.487E+01	2.290	0.389E+03	0.650E-01	0.217E+03	0.141E-04	45.8	58.5	0.0
0.653E+02	0.444E+05	0.226E+05	0.279E+01	2.273	0.381E+03	0.638E-01	0.217E+03	0.141E-04	45.8	56.9	0.0
0.678E+02	0.461E+05	0.227E+05	0.714E+00	2.258	0.378E+03	0.633E-01	0.217E+03	0.141E-04	45.8	55.9	0.0
0.703E+02	0.477E+05	0.227E+05	-0.160E+01	2.247	0.379E+03	0.633E-01	0.217E+03	0.141E-04	45.8	55.5	0.0
0.728E+02	0.494E+05	0.226E+05	-0.351E+01	2.239	0.382E+03	0.639E-01	0.217E+03	0.141E-04	45.8	55.7	0.0
0.753E+02	0.510E+05	0.225E+05	-0.563E+01	2.233	0.389E+03	0.651E-01	0.217E+03	0.141E-04	45.8	56.4	0.0
0.778E+02	0.527E+05	0.223E+05	-0.774E+01	2.231	0.401E+03	0.669E-01	0.217E+03	0.141E-04	45.8	57.7	0.0
0.803E+02	0.543E+05	0.220E+05	-0.943E+01	2.231	0.416E+03	0.694E-01	0.217E+03	0.141E-04	45.8	59.6	0.0
0.827E+02	0.559E+05	0.217E+05	-0.119E+02	2.234	0.437E+03	0.726E-01	0.217E+03	0.141E-04	45.8	62.2	0.0
0.852E+02	0.575E+05	0.213E+05	-0.140E+02	2.239	0.463E+03	0.765E-01	0.217E+03	0.141E-04	45.8	65.5	0.0
0.877E+02	0.591E+05	0.209E+05	-0.160E+02	2.247	0.494E+03	0.816E-01	0.217E+03	0.141E-04	45.8	69.7	0.0
0.902E+02	0.607E+05	0.204E+05	-0.180E+02	2.256	0.533E+03	0.876E-01	0.217E+03	0.141E-04	45.8	74.7	0.0
0.927E+02	0.622E+05	0.198E+05	-0.200E+02	2.267	0.580E+03	0.948E-01	0.217E+03	0.141E-04	45.8	80.9	0.0
0.952E+02	0.638E+05	0.192E+05	-0.220E+02	2.280	0.637E+03	0.103E+00	0.217E+03	0.141E-04	45.8	88.1	0.0
0.977E+02	0.654E+05	0.186E+05	-0.239E+02	2.294	0.705E+03	0.114E+00	0.217E+03	0.141E-04	45.8	96.9	0.0
0.100E+03	0.669E+05	0.178E+05	-0.258E+02	2.308	0.787E+03	0.126E+00	0.217E+03	0.141E-04	45.8	107.3	0.0
0.103E+03	0.684E+05	0.171E+05	-0.276E+02	2.324	0.886E+03	0.141E+00	0.217E+03	0.141E-04	45.8	119.6	0.0
0.105E+03	0.699E+05	0.162E+05	-0.294E+02	2.339	0.100E+04	0.159E+00	0.217E+03	0.141E-04	45.8	134.2	0.0
0.108E+03	0.714E+05	0.154E+05	-0.311E+02	2.354	0.115E+04	0.179E+00	0.217E+03	0.141E-04	45.8	151.5	0.0
0.110E+03	0.729E+05	0.144E+05	-0.329E+02	2.367	0.132E+04	0.204E+00	0.217E+03	0.141E-04	45.8	171.8	0.0
0.113E+03	0.743E+05	0.135E+05	-0.345E+02	2.378	0.153E+04	0.233E+00	0.217E+03	0.141E-04	45.8	195.6	0.0
0.115E+03	0.758E+05	0.124E+05	-0.362E+02	2.388	0.178E+04	0.264E+00	0.217E+03	0.141E-04	45.8	223.5	0.0
0.118E+03	0.772E+05	0.114E+05	-0.377E+02	2.393	0.209E+04	0.310E+00	0.217E+03	0.141E-04	45.8	255.8	0.0
0.120E+03	0.785E+05	0.103E+05	-0.393E+02	2.378	0.246E+04	0.359E+00	0.220E+03	0.149E-04	45.8	295.2	0.0
0.123E+03	0.799E+05	0.913E+04	-0.408E+02	2.337	0.293E+04	0.417E+00	0.227E+03	0.152E-04	45.8	341.2	0.0
0.125E+03	0.812E+05	0.797E+04	-0.423E+02	2.289	0.344E+04	0.485E+00	0.234E+03	0.154E-04	45.8	393.0	0.0
0.128E+03	0.825E+05	0.678E+04	-0.438E+02	2.234	0.408E+04	0.56[illegible]E+00	0.242E+03	0.157E-04	45.8	450.5	0.0
0.130E+03	0.837E+05	0.557E+04	-0.453E+02	2.170	[illegible]	[illegible]	0.250E+03	0.161E-04	45.8	513.9	0.0
0.133E+03	0.848E+05	0.43[illegible]E+04	-0.4[illegible]7E+02	[illegible]	0.573E+04	0.751E+00	0.258E+03	0.164E-04	45.8	583.5	0.0
0.135E+03	0.859E+05	0.314E+04	-0.482E+02	2.017	0.677E+04	0.871E+00	0.266E+03	0.168E-04	45.8	677.1	0.0
0.137E+03	0.870E+05	0.193E+04	-0.49[illegible]E+02	1.927	0.794E+04	0.997E+00	0.274E+03	0.171E-04	45.8	749.9	0.0
0.140E+03	0.880E+05	0.740E+03	-0.511E+02	1.829	0.922E+04	0.112E+01	0.282E+03	0.175E-04	45.8	814.5	0.0

FILE: TRJ D / A NAVAL POSTGRADUATE SCHOOL PAGE 002

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 0.142E+03 0.887E+05-0.135E+03-0.522E+02 1.754 0.192E+05 0.121E+01 0.287E+03 0.179E-04   45.8  848.6    0.0
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B

FILE: DRG D : A NAVAL POSTGRADUATE SCHOOL PAGE 001

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RAMJET TRAJECTORY

(DRAG COEF.)

LPR	WPR	A30	A0/AR	A5/AR	L3	U0	U	WB	TCEV
0.155E+01	0.475E+02	0.530E-02	0.280E+00	0.260E+01	0.584E+00	0.762E+03	0.863E+03	0.199E+01	0.124E+03

TETP	CDN	CDS	CDWW	CDWF	APR	SPR	SWW	Q	XMO
9.50	0.864E-01	0.210E-02	0.974E-02	0.346E-02	0.127E-01	0.618E+00	0.484E-01	0.456E+06	1.40
9.50	0.857E-01	0.214E-02	0.967E-02	0.355E-02	0.127E-01	0.618E+00	0.484E-01	0.375E+06	1.40
9.50	0.845E-01	0.218E-02	0.955E-02	0.363E-02	0.127E-01	0.618E+00	0.484E-01	0.318E+06	1.40
9.50	0.832E-01	0.223E-02	0.939E-02	0.373E-02	0.127E-01	0.618E+00	0.484E-01	0.270E+06	1.40
9.50	0.819E-01	0.227E-02	0.925E-02	0.383E-02	0.127E-01	0.618E+00	0.484E-01	0.228E+06	1.40
9.50	0.808E-01	0.232E-02	0.913E-02	0.978E-03	0.127E-01	0.618E+00	0.484E-01	0.191E+06	1.40
9.50	0.799E-01	0.238E-02	0.903E-02	0.105E-02	0.127E-01	0.618E+00	0.484E-01	0.160E+06	1.40
9.50	0.792E-01	0.243E-02	0.896E-02	0.114E-02	0.127E-01	0.618E+00	0.484E-01	0.134E+06	1.40
9.50	0.788E-01	0.247E-02	0.892E-02	0.120E-02	0.127E-01	0.618E+00	0.484E-01	0.112E+06	1.40
9.50	0.797E-01	0.255E-02	0.901E-02	0.130E-02	0.127E-01	0.618E+00	0.484E-01	0.938E+05	1.40
9.50	0.806E-01	0.260E-02	0.911E-02	0.141E-02	0.127E-01	0.618E+00	0.484E-01	0.790E+05	1.40
9.50	0.815E-01	0.266E-02	0.921E-02	0.152E-02	0.127E-01	0.618E+00	0.484E-01	0.670E+05	1.40
9.50	0.824E-01	0.272E-02	0.931E-02	0.164E-02	0.127E-01	0.618E+00	0.484E-01	0.572E+05	1.40
9.50	0.833E-01	0.278E-02	0.940E-02	0.176E-02	0.127E-01	0.618E+00	0.484E-01	0.492E+05	1.40
9.50	0.841E-01	0.284E-02	0.950E-02	0.188E-02	0.127E-01	0.618E+00	0.484E-01	0.426E+05	1.40
9.50	0.850E-01	0.290E-02	0.959E-02	0.200E-02	0.127E-01	0.618E+00	0.484E-01	0.372E+05	1.40
9.50	0.858E-01	0.296E-02	0.968E-02	0.212E-02	0.127E-01	0.618E+00	0.484E-01	0.328E+05	1.40
9.50	0.866E-01	0.301E-02	0.977E-02	0.224E-02	0.127E-01	0.618E+00	0.484E-01	0.292E+05	1.40
9.50	0.873E-01	0.306E-02	0.985E-02	0.236E-02	0.127E-01	0.618E+00	0.484E-01	0.262E+05	1.40
9.50	0.886E-01	0.311E-02	0.999E-02	0.247E-02	0.127E-01	0.618E+00	0.484E-01	0.234E+05	1.40
9.50	0.900E-01	0.316E-02	0.101E-01	0.259E-02	0.127E-01	0.618E+00	0.484E-01	0.211E+05	1.40
9.50	0.914E-01	0.320E-02	0.103E-01	0.269E-02	0.127E-01	0.618E+00	0.484E-01	0.192E+05	1.40
9.50	0.927E-01	0.324E-02	0.104E-01	0.278E-02	0.127E-01	0.618E+00	0.484E-01	0.177E+05	1.40
9.50	0.938E-01	0.327E-02	0.105E-01	0.286E-02	0.127E-01	0.618E+00	0.484E-01	0.165E+05	1.40
9.50	0.948E-01	0.329E-02	0.107E-01	0.293E-02	0.127E-01	0.618E+00	0.484E-01	0.156E+05	1.40
9.50	0.957E-01	0.331E-02	0.108E-01	0.299E-02	0.127E-01	0.618E+00	0.484E-01	0.149E+05	1.40
9.50	0.963E-01	0.333E-02	0.108E-01	0.302E-02	0.127E-01	0.618E+00	0.484E-01	0.144E+05	1.40
9.50	0.968E-01	0.334E-02	0.109E-01	0.305E-02	0.127E-01	0.618E+00	0.484E-01	0.141E+05	1.40
9.50	0.973E-01	0.334E-02	0.110E-01	0.305E-02	0.127E-01	0.618E+00	0.484E-01	0.140E+05	1.40
9.50	0.976E-01	0.334E-02	0.110E-01	0.305E-02	0.127E-01	0.618E+00	0.484E-01	0.140E+05	1.40
9.50	0.978E-01	0.333E-02	0.110E-01	0.302E-02	0.127E-01	0.618E+00	0.484E-01	0.142E+05	1.40
9.50	0.979E-01	0.331E-02	0.110E-01	0.298E-02	0.127E-01	0.618E+00	0.484E-01	0.146E+05	1.40
9.50	0.978E-01	0.329E-02	0.110E-01	0.293E-02	0.127E-01	0.618E+00	0.484E-01	0.151E+05	1.40
9.50	0.977E-01	0.327E-02	0.110E-01	0.286E-02	0.127E-01	0.618E+00	0.484E-01	0.158E+05	1.40
9.50	0.976E-01	0.323E-02	0.110E-01	0.278E-02	0.127E-01	0.618E+00	0.484E-01	0.168E+05	1.40
9.50	0.973E-01	0.320E-02	0.110E-01	0.269E-02	0.127E-01	0.618E+00	0.484E-01	0.180E+05	1.40
9.50	0.969E-01	0.316E-02	0.109E-01	0.259E-02	0.127E-01	0.618E+00	0.484E-01	0.195E+05	1.40
9.50	0.965E-01	0.311E-02	0.109E-01	0.248E-02	0.127E-01	0.618E+00	0.484E-01	0.213E+05	1.40
9.50	0.960E-01	0.307E-02	0.108E-01	0.237E-02	0.127E-01	0.618E+00	0.484E-01	0.235E+05	1.40
9.50	0.955E-01	0.302E-02	0.107E-01	0.225E-02	0.127E-01	0.618E+00	0.484E-01	0.262E+05	1.40
9.50	0.949E-01	0.296E-02	0.107E-01	0.214E-02	0.127E-01	0.618E+00	0.484E-01	0.294E+05	1.40
9.50	0.943E-01	0.291E-02	0.106E-01	0.201E-02	0.127E-01	0.618E+00	0.484E-01	0.332E+05	1.40
9.50	0.937E-01	0.285E-02	0.105E-01	0.189E-02	0.127E-01	0.618E+00	0.484E-01	0.378E+05	1.40
9.50	0.931E-01	0.279E-02	0.105E-01	0.177E-02	0.127E-01	0.618E+00	0.484E-01	0.433E+05	1.40
9.50	0.925E-01	0.273E-02	0.104E-01	0.166E-02	0.127E-01	0.618E+00	0.484E-01	0.499E+05	1.40
9.50	0.921E-01	0.267E-02	0.104E-01	0.155E-02	0.127E-01	0.618E+00	0.484E-01	0.576E+05	1.40
9.50	0.917E-01	0.261E-02	0.103E-01	0.144E-02	0.127E-01	0.618E+00	0.484E-01	0.669E+05	1.40
9.50	0.915E-01	0.255E-02	0.103E-01	0.134E-02	0.127E-01	0.618E+00	0.484E-01	0.775E+05	1.40
9.50	0.921E-01	0.252E-02	0.104E-01	0.128E-02	0.127E-01	0.618E+00	0.484E-01	0.899E+05	1.40
9.50	0.937E-01	0.247E-02	0.105E-01	0.120E-02	0.127E-01	0.618E+00	0.484E-01	0.104E+06	1.40
9.50	0.957E-01	0.242E-02	0.108E-01	0.112E-02	0.127E-01	0.618E+00	0.484E-01	0.120E+06	1.40
9.50	0.978E-01	0.239E-02	0.110E-01	0.106E-02	0.127E-01	0.618E+00	0.484E-01	0.137E+06	1.40
9.50	0.101E+00	0.234E-02	0.113E-01	0.995E-03	0.127E-01	0.618E+00	0.484E-01	0.155E+06	1.40

D

9.50	0.105E+00	0.230E-02	0.117E-01	0.943E-03	0.127E-01	0.618E+00	0.484E-01	0.173E+06	1.40
9.50	0.110E+00	0.227E-02	0.122E-01	0.381E-02	0.127E-01	0.618E+00	0.484E-01	0.190E+06	1.40
9.50	0.118E+00	0.224E-02	0.128E-01	0.376E-02	0.127E-01	0.618E+00	0.484E-01	0.204E+06	1.40
9.50	0.127E+00	0.222E-02	0.135E-01	0.372E-02	0.127E-01	0.618E+00	0.484E-01	0.213E+06	1.40
9.50	0.134E+00	0.221E-02	0.141E-01	0.370E-02	0.127E-01	0.618E+00	0.484E-01	0.216E+06	1.40

FILE: CMB D : A NAVAL POSTGRADUATE SCHOOL PAGE 001

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CCCCCCCCCCCCCCCCCCCCCCCCCCCCC
CCC                       CCC
CCC   SOLID FUEL RAMJET   CCC
CCC                       CCC
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GEOMETRICAL DATA:

AREF= 0.1245E-01M2 L3= 0.5842E+00M TETP= 9.5

AO/AREF	AIC/AO	AI/AO	A2/AO	A3/AREF	A5/AREF	A6/A5
0.2800	0.8194	0.4700	0.8869	0.4259	0.2600	3.8462

MO	MIC	M6
2.5336	2.3136	2.6646

CONSTANT LOSSES:

PID1= 0.930 PID2= 0.930 PIN= 0.960

INITIAL FLIGHT CONDITIONS:

PO(KG/M2)	TO(K)	ROO(KG/M3)	PTO(KG/M2)	TTO(K)	GA
0.103E+05	0.288E+03	0.122E+01	0.186E+06	0.658E+03	1.400

TIME	MO	AS/AO	WA	WF/WA	M2	M3N	M3I	M4	TOTAL PRES. RATIOS 1C/0	12/11	3/2	4/3	6/0	GF	TT4(K)	CF	F(N)	ISP
0.62	2.53	0.516	2.929	6.596	0.307	0.163	0.180	0.391	0.996	0.830	0.958	0.940	0.620	1.25	2258.8	0.242	1370.6	7094.8
1.24	2.54	0.516	2.929	6.570	0.307	0.158	0.173	0.373	0.996	0.830	0.957	0.944	0.619	1.25	2255.0	0.241	1363.8	7087.8
1.87	2.54	0.503	2.760	6.703	0.300	0.151	0.163	0.357	0.996	0.841	0.957	0.948	0.628	1.25	2268.3	0.263	1393.5	7477.9
2.49	2.55	0.503	2.666	6.776	0.300	0.146	0.158	0.345	0.996	0.841	0.956	0.951	0.634	1.25	2272.4	0.274	1379.6	7637.0
3.11	2.55	0.496	2.571	6.854	0.296	0.141	0.152	0.333	0.996	0.846	0.956	0.954	0.637	1.25	2277.5	0.283	1365.0	7744.5
3.73	2.56	0.496	2.477	6.939	0.296	0.137	0.147	0.324	0.996	0.843	0.955	0.956	0.638	1.25	2283.4	0.290	1343.6	7816.2
4.35	2.57	0.496	2.385	7.028	0.295	0.133	0.144	0.315	0.996	0.839	0.955	0.959	0.637	1.25	2290.0	0.297	1317.6	7860.9
4.98	2.58	0.490	2.294	7.123	0.291	0.130	0.139	0.307	0.996	0.842	0.956	0.959	0.635	1.25	2297.2	0.302	1288.3	7894.6
5.60	2.59	0.490	2.205	7.221	0.291	0.126	0.136	0.303	0.996	0.837	0.955	0.961	0.633	1.25	2305.0	0.306	1256.8	7891.6
6.22	2.60	0.490	2.119	7.323	0.290	0.124	0.133	0.294	0.996	0.831	0.955	0.962	0.629	1.25	2312.0	0.310	1222.6	7877.1
6.84	2.61	0.496	2.076	7.430	0.292	0.121	0.131	0.289	0.996	0.819	0.954	0.963	0.624	1.25	2315.1	0.312	1183.2	7822.6
7.47	2.62	0.496	1.955	7.540	0.291	0.119	0.129	0.284	0.996	0.812	0.954	0.964	0.619	1.25	2318.5	0.314	1141.7	7759.9
8.09	2.63	0.496	1.877	7.653	0.290	0.117	0.127	0.280	0.995	0.806	0.954	0.965	0.613	1.25	2322.0	0.316	1104.7	7692.6
8.71	2.64	0.496	1.801	7.769	0.289	0.115	0.125	0.276	0.995	0.800	0.954	0.966	0.607	1.25	2322.2	0.316	1063.3	7599.2
9.33	2.65	0.503	1.728	7.889	0.291	0.113	0.124	0.272	0.995	0.786	0.953	0.967	0.601	1.25	2320.1	0.316	1020.9	7497.1
9.95	2.66	0.503	1.658	8.012	0.291	0.111	0.122	0.269	0.995	0.780	0.953	0.968	0.595	1.25	2317.8	0.315	979.6	7373.9
10.58	2.67	0.503	1.591	8.138	0.290	0.110	0.121	0.266	0.995	0.775	0.953	0.968	0.589	1.25	2315.5	0.315	939.9	7261.1
11.20	2.68	0.509	1.526	8.267	0.292	0.108	0.121	0.263	0.995	0.762	0.952	0.969	0.583	1.25	2313.0	0.314	901.7	7149.0
11.82	2.69	0.509	1.464	8.398	0.291	0.107	0.119	0.261	0.995	0.757	0.952	0.969	0.577	1.25	2305.2	0.312	859.4	6992.1
12.44	2.70	0.512	1.404	8.533	0.292	0.106	0.119	0.258	0.995	0.748	0.952	0.970	0.571	1.25	2295.3	0.309	817.1	6821.7
13.06	2.71	0.516	1.347	8.670	0.293	0.105	0.118	0.256	0.995	0.739	0.951	0.970	0.563	1.25	2285.4	0.305	775.8	6644.8
13.69	2.72	0.519	1.292	8.809	0.294	0.104	0.118	0.254	0.995	0.730	0.951	0.970	0.557	1.26	2275.1	0.302	736.6	6473.6
14.31	2.73	0.522	1.239	8.951	0.295	0.103	0.118	0.253	0.995	0.722	0.951	0.971	0.551	1.26	2264.6	0.299	699.7	6303.2
14.93	2.73	0.522	1.189	9.076	0.295	0.103	0.117	0.251	0.995	0.718	0.951	0.971	0.545	1.26	2253.7	0.295	664.8	6148.2
15.55	2.74	0.529	1.141	9.243	0.297	0.102	0.117	0.251	0.994	0.707	0.950	0.971	0.540	1.26	2240.2	0.293	632.6	6030.3
16.17	2.75	0.529	1.095	9.392	0.297	0.101	0.117	0.248	0.994	0.704	0.950	0.971	0.535	1.26	2226.4	0.291	602.1	5856.7
16.80	2.75	0.532	1.051	9.543	0.298	0.100	0.116	0.247	0.994	0.697	0.949	0.972	0.531	1.26	2212.2	0.288	573.2	5716.6
17.42	2.76	0.535	1.009	9.697	0.299	0.100	0.117	0.246	0.994	0.690	0.949	0.972	0.527	1.26	2197.8	0.286	545.7	5579.7
18.04	2.76	0.535	0.968	9.852	0.299	0.099	0.117	0.245	0.994	0.684	0.949	0.972	0.523	1.26	2183.2	0.284	519.6	5445.9

18.66	2.77	0.535	0.93010.009	0.298	0.099	0.115	0.244	0.994	0.685	0.949	0.972	0.519	1.26	2168.2	0.282	494.7	5314.0
19.29	2.77	0.542	0.89410.168	0.301	0.098	0.116	0.244	0.994	0.676	0.948	0.972	0.516	1.26	2151.6	0.279	469.6	5168.6
19.91	2.78	0.542	0.85910.329	0.301	0.098	0.116	0.243	0.994	0.674	0.949	0.972	0.512	1.26	2134.7	0.275	445.8	5026.8
20.53	2.78	0.545	0.82510.492	0.303	0.097	0.116	0.242	0.994	0.669	0.947	0.972	0.509	1.26	2117.7	0.273	423.3	4889.1
21.15	2.77	0.545	0.79310.656	0.303	0.097	0.116	0.242	0.994	0.669	0.947	0.972	0.509	1.27	2100.8	0.272	404.2	4781.6
21.77	2.76	0.542	0.76310.822	0.301	0.097	0.115	0.241	0.994	0.676	0.948	0.972	0.515	1.27	2084.5	0.276	390.7	4721.8
22.40	2.75	0.535	0.73410.989	0.299	0.097	0.114	0.241	0.994	0.686	0.949	0.973	0.521	1.27	2068.1	0.280	377.6	4691.0
23.02	2.75	0.535	0.70611.157	0.299	0.096	0.114	0.240	0.994	0.690	0.948	0.973	0.527	1.27	2051.9	0.284	365.0	4631.3
23.64	2.74	0.529	0.68011.327	0.296	0.096	0.113	0.240	0.994	0.701	0.949	0.973	0.533	1.27	2036.2	0.288	353.2	4546.3
24.26	2.73	0.529	0.65511.498	0.297	0.096	0.113	0.239	0.994	0.705	0.949	0.973	0.539	1.27	2020.4	0.292	341.8	4539.5
24.88	2.72	0.522	0.63111.670	0.294	0.096	0.112	0.239	0.995	0.716	0.950	0.972	0.545	1.27	2004.6	0.296	330.6	4490.7
25.51	2.72	0.522	0.60811.843	0.295	0.096	0.112	0.239	0.995	0.720	0.950	0.973	0.551	1.27	1988.7	0.300	319.7	4440.6
26.13	2.71	0.516	0.58612.016	0.292	0.096	0.111	0.239	0.995	0.731	0.951	0.973	0.557	1.28	1972.9	0.303	309.0	4399.0
26.75	2.70	0.516	0.56512.191	0.293	0.095	0.111	0.238	0.995	0.735	0.950	0.973	0.563	1.28	1956.8	0.307	298.8	4336.4
27.37	2.69	0.509	0.54512.367	0.290	0.095	0.110	0.238	0.995	0.747	0.951	0.973	0.568	1.28	1940.7	0.310	288.8	4292.9
27.99	2.69	0.509	0.52612.543	0.291	0.095	0.110	0.238	0.995	0.751	0.951	0.973	0.574	1.28	1924.6	0.313	279.1	4228.6
28.62	2.68	0.506	0.50812.720	0.290	0.095	0.109	0.238	0.995	0.758	0.951	0.973	0.580	1.28	1909.3	0.317	270.1	4177.9
29.24	2.67	0.503	0.49112.898	0.289	0.095	0.109	0.238	0.995	0.766	0.952	0.973	0.587	1.29	1895.6	0.321	262.2	4142.4
29.86	2.66	0.496	0.47413.075	0.286	0.095	0.108	0.238	0.995	0.778	0.953	0.973	0.593	1.28	1881.9	0.325	254.4	4104.2
30.48	2.66	0.496	0.45813.254	0.287	0.095	0.108	0.238	0.995	0.782	0.952	0.973	0.599	1.28	1868.1	0.329	247.0	4065.2
31.11	2.65	0.490	0.44313.432	0.284	0.095	0.107	0.238	0.995	0.793	0.953	0.973	0.606	1.28	1854.4	0.333	239.7	4025.7
31.73	2.64	0.490	0.42913.611	0.285	0.095	0.107	0.238	0.995	0.797	0.953	0.973	0.612	1.28	1840.7	0.337	232.7	3985.7
32.35	2.63	0.483	0.41513.789	0.282	0.095	0.107	0.238	0.995	0.809	0.954	0.973	0.618	1.29	1827.1	0.341	225.8	3945.3
32.97	2.63	0.483	0.40213.968	0.283	0.095	0.107	0.238	0.995	0.813	0.954	0.973	0.624	1.29	1813.4	0.344	219.2	3904.6
33.59	2.62	0.477	0.38914.146	0.280	0.095	0.106	0.238	0.995	0.825	0.954	0.973	0.630	1.29	1799.9	0.348	212.9	3863.8
34.22	2.61	0.477	0.37714.325	0.281	0.095	0.106	0.238	0.995	0.829	0.954	0.973	0.636	1.29	1786.3	0.351	206.7	3822.9
34.84	2.61	0.473	0.36614.503	0.280	0.095	0.106	0.238	0.995	0.836	0.954	0.973	0.642	1.29	1772.8	0.354	200.7	3781.9

TETA= 45.0 TIME OF BURNING= 34.84 SEC RANGE OF BURNING=0.2342E+05 KM HEIGHT OF BURNING=0.1709E+05 KM

RAMJET TRAJECTORY

LPR	WPR	A30	AO/AR	A5/AR	L3	UO	U	WB	TOEV
0.155E+01	0.475E+02	0.530E-02	0.280E+00	0.260E+01	0.584E+00	0.762E+03	0.863E+03	0.199E+01	0.124E+03

TI	X3	Y3	TETA	MO	PO	RHOA	TO	MUA	WPF	DRAG	THRUST
0.622E+00	0.759E+03	0.755E+03	0.447E+02	2.534	0.103E+05	0.122E+01	0.288E+03	0.179E-04	47.5	1381.3	1370.6
0.311E+01	0.228E+04	0.223E+04	0.435E+02	2.552	0.832E+04	0.104E+01	0.276E+03	0.172E-04	47.0	1143.9	1365.0
0.560E+01	0.283E+04	0.366E+04	0.423E+02	2.587	0.689E+04	0.886E+00	0.267E+03	0.168E-04	46.7	973.3	1256.8
0.809E+01	0.541E+04	0.506E+04	0.411E+02	2.630	0.569E+04	0.751E+00	0.257E+03	0.164E-04	46.5	826.8	1104.7
0.106E+02	0.701E+04	0.642E+04	0.398E+02	2.672	0.470E+04	0.638E+00	0.248E+03	0.160E-04	46.3	700.1	939.9
0.131E+02	0.864E+04	0.774E+04	0.386E+02	2.710	0.389E+04	0.540E+00	0.240E+03	0.157E-04	46.1	564.3	775.8
0.156E+02	0.103E+05	0.901E+04	0.372E+02	2.742	0.323E+04	0.458E+00	0.231E+03	0.153E-04	46.0	475.8	632.6
0.180E+02	0.120E+05	0.102E+05	0.359E+02	2.765	0.269E+04	0.389E+00	0.224E+03	0.150E-04	45.9	401.0	515.6
0.205E+02	0.136E+05	0.114E+05	0.345E+02	2.778	0.225E+04	0.332E+00	0.217E+03	0.141E-04	45.9	337.4	423.3
0.230E+02	0.153E+05	0.125E+05	0.331E+02	2.746	0.190E+04	0.284E+00	0.217E+03	0.141E-04	45.9	288.3	365.0
0.255E+02	0.170E+05	0.136E+05	0.316E+02	2.715	0.157E+04	0.245E+00	0.217E+03	0.141E-04	45.8	247.7	319.7
0.280E+02	0.187E+05	0.146E+05	0.301E+02	2.685	0.138E+04	0.212E+00	0.217E+03	0.141E-04	45.8	214.0	279.1
0.305E+02	0.204E+05	0.156E+05	0.286E+02	2.656	0.119E+04	0.185E+00	0.217E+03	0.141E-04	45.8	186.1	247.0
0.330E+02	0.221E+05	0.165E+05	0.270E+02	2.628	0.104E+04	0.163E+00	0.217E+03	0.141E-04	45.8	163.0	219.2
0.355E+02	0.239E+05	0.173E+05	0.253E+02	2.601	0.909E+03	0.144E+00	0.217E+03	0.141E-04	45.8	143.7	0.0
0.379E+02	0.256E+05	0.181E+05	0.237E+02	2.541	0.804E+03	0.129E+00	0.217E+03	0.141E-04	45.8	125.4	0.0
0.404E+02	0.273E+05	0.188E+05	0.219E+02	2.486	0.719E+03	0.116E+00	0.217E+03	0.141E-04	45.8	110.5	0.0
0.429E+02	0.289E+05	0.194E+05	0.201E+02	2.436	0.649E+03	0.105E+00	0.217E+03	0.141E-04	45.8	98.5	0.0
0.454E+02	0.306E+05	0.200E+05	0.182E+02	2.291	0.591E+03	0.965E-01	0.217E+03	0.141E-04	45.8	88.7	0.0
0.479E+02	0.323E+05	0.205E+05	0.163E+02	2.350	0.545E+03	0.893E-01	0.217E+03	0.141E-04	45.8	80.7	0.0
0.504E+02	0.339E+05	0.209E+05	0.144E+02	2.313	0.506E+03	0.834E-01	0.217E+03	0.141E-04	45.8	74.2	0.0
0.529E+02	0.355E+05	0.213E+05	0.124E+02	2.279	0.476E+03	0.787E-01	0.217E+03	0.141E-04	45.8	68.9	0.0
0.554E+02	0.372E+05	0.216E+05	0.103E+02	2.249	0.451E+03	0.748E-01	0.217E+03	0.141E-04	45.8	64.6	0.0
0.579E+02	0.388E+05	0.219E+05	0.822E+01	2.222	0.432E+03	0.719E-01	0.217E+03	0.141E-04	45.8	61.2	0.0
0.603E+02	0.404E+05	0.221E+05	0.609E+01	2.199	0.418E+03	0.696E-01	0.217E+03	0.141E-04	45.8	58.6	0.0
0.628E+02	0.420E+05	0.222E+05	0.394E+01	2.180	0.408E+03	0.681E-01	0.217E+03	0.141E-04	45.8	56.7	0.0
0.653E+02	0.436E+05	0.223E+05	0.176E+01	2.164	0.403E+03	0.672E-01	0.217E+03	0.141E-04	45.9	55.5	0.0
0.678E+02	0.452E+05	0.223E+05	-0.441E+00	2.151	0.401E+03	0.670E-01	0.217E+03	0.141E-04	45.8	54.9	0.0
0.703E+02	0.467E+05	0.223E+05	-0.265E+01	2.141	0.403E+03	0.673E-01	0.217E+03	0.141E-04	45.8	54.8	0.0
0.728E+02	0.483E+05	0.221E+05	-0.486E+01	2.135	0.409E+03	0.683E-01	0.217E+03	0.141E-04	45.8	55.3	0.0
0.753E+02	0.499E+05	0.220E+05	-0.707E+01	2.131	0.420E+03	0.699E-01	0.217E+03	0.141E-04	45.8	56.3	0.0
0.778E+02	0.514E+05	0.217E+05	-0.927E+01	2.131	0.434E+03	0.722E-01	0.217E+03	0.141E-04	45.8	57.9	0.0
0.803E+02	0.530E+05	0.215E+05	-0.115E+02	2.134	0.454E+03	0.752E-01	0.217E+03	0.141E-04	45.8	60.2	0.0
0.827E+02	0.545E+05	0.211E+05	-0.136E+02	2.138	0.478E+03	0.791E-01	0.217E+03	0.141E-04	45.8	63.1	0.0
0.852E+02	0.560E+05	0.207E+05	-0.158E+02	2.146	0.509E+03	0.838E-01	0.217E+03	0.141E-04	45.8	66.9	0.0
0.877E+02	0.575E+05	0.202E+05	-0.179E+02	2.155	0.546E+03	0.896E-01	0.217E+03	0.141E-04	45.8	71.4	0.0
0.902E+02	0.590E+05	0.197E+05	-0.200E+02	2.167	0.592E+03	0.966E-01	0.217E+03	0.141E-04	45.8	77.0	0.0
0.927E+02	0.605E+05	0.191E+05	-0.220E+02	2.180	0.647E+03	0.105E+00	0.217E+03	0.141E-04	45.8	83.7	0.0
0.952E+02	0.620E+05	0.185E+05	-0.240E+02	2.195	0.713E+03	0.115E+00	0.217E+03	0.141E-04	45.8	91.7	0.0
0.977E+02	0.635E+05	0.178E+05	-0.260E+02	2.211	0.793E+03	0.127E+00	0.217E+03	0.141E-04	45.8	101.3	0.0
0.100E+03	0.649E+05	0.170E+05	-0.279E+02	2.228	0.889E+03	0.141E+00	0.217E+03	0.141E-04	45.8	112.7	0.0
0.103E+03	0.664E+05	0.162E+05	-0.297E+02	2.244	0.100E+04	0.158E+00	0.217E+03	0.141E-04	45.9	126.3	0.0
0.105E+03	0.678E+05	0.154E+05	-0.315E+02	2.261	0.114E+04	0.178E+00	0.217E+03	0.141E-04	45.8	142.4	0.0
0.108E+03	0.692E+05	0.145E+05	-0.333E+02	2.277	0.131E+04	0.202E+00	0.217E+03	0.141E-04	45.8	161.4	0.0
0.110E+03	0.706E+05	0.135E+05	-0.350E+02	2.291	0.151E+04	0.230E+00	0.217E+03	0.141E-04	45.8	183.6	0.0
0.113E+03	0.720E+05	0.125E+05	-0.367E+02	2.303	0.175E+04	0.264E+00	0.217E+03	0.141E-04	45.8	209.7	0.0
0.115E+03	0.733E+05	0.115E+05	-0.383E+02	2.312	0.205E+04	0.304E+00	0.217E+03	0.141E-04	45.8	239.9	0.0
0.118E+03	0.746E+05	0.104E+05	-0.399E+02	2.306	0.240E+04	0.352E+00	0.219E+03	0.149E-04	45.8	276.6	0.0
0.120E+03	0.759E+05	0.937E+04	-0.415E+02	2.271	0.283E+04	0.408E+00	0.226E+03	0.151E-04	45.8	319.5	0.0
0.123E+03	0.772E+05	0.816E+04	-0.430E+02	2.229	0.335E+04	0.473E+00	0.233E+03	0.154E-04	45.8	369.1	0.0
0.125E+03	0.784E+05	0.698E+04	-0.445E+02	2.181	0.396E+04	0.549E+00	0.240E+03	0.157E-04	45.8	423.2	0.0
0.128E+03	0.796E+05	0.570E+04	-0.460E+02	2.124	0.469E+04	0.637E+00	0.248E+03	0.160E-04	45.8	494.7	0.0
0.130E+03	0.807E+05	0.456E+04	-0.475E+02	2.063	0.555E+04	0.737E+00	0.256E+03	0.163E-04	45.8	559.4	0.0
0.133E+03	0.818E+05	0.331E+04	-0.489E+02	1.987	0.655E+04	[illegible]	0.264E+03	0.167E-04	45.8	663.6	0.0
0.135E+03	0.826E+05	0.210E+04	-0.504E+02	1.902	[illegible]	0.971E+00	0.272E+03	0.170E-04	45.8	716.7	0.0
0.137E+03	0.837E+05	0.992E+03	-0.518E+02	1.811	0.874E+04	0.111E+01	0.280E+03	0.174E-04	45.8	782.0	0.0
0.140E+03	0.846E+05	-0.170E+03	-0.533E+02	1.716	0.102E+05	0.122E+01	0.288E+03	0.179E-04	45.8	828.6	0.0

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RAMJET TRAJECTORY

(DRAG COFF.)

LPR	WPR	A30	A0/AR	A5/AR	L3	U0	U	WR	TDEV
0.155E+01	0.475E+02	0.530E-02	0.280E+00	0.260E+00	0.584E+00	0.762E+03	0.963E+03	0.199E+01	0.124E+03

TETP	CDN	CDS	CDWW	CDWF	APR	SPR	SWW	Q	XMO
9.50	0.864E-01	0.210E-02	0.974E-02	0.346E-02	0.127E-01	0.618E+00	0.484E-01	0.456E+06	1.40
9.50	0.857E-01	0.214E-02	0.967E-02	0.355E-02	0.127E-01	0.618E+00	0.494E-01	0.375E+06	1.40
9.50	0.845E-01	0.218E-02	0.955E-02	0.363E-02	0.127E-01	0.618E+00	0.484E-01	0.318E+06	1.40
9.50	0.832E-01	0.223E-02	0.939E-02	0.373E-02	0.127E-01	0.618E+00	0.484E-01	0.270E+06	1.40
9.50	0.819E-01	0.227E-02	0.925E-02	0.383E-02	0.127E-01	0.618E+00	0.484E-01	0.228E+06	1.40
9.50	0.808E-01	0.232E-02	0.913E-02	0.978E-03	0.127E-01	0.618E+00	0.484E-01	0.191E+06	1.40
9.50	0.799E-01	0.238E-02	0.903E-02	0.105E-02	0.127E-01	0.618E+00	0.484E-01	0.160E+06	1.40
9.50	0.792E-01	0.243E-02	0.896E-02	0.114E-02	0.127E-01	0.618E+00	0.484E-01	0.134E+06	1.40
9.50	0.788E-01	0.247E-02	0.892E-02	0.120E-02	0.127E-01	0.618E+00	0.484E-01	0.112E+06	1.40
9.50	0.797E-01	0.253E-02	0.901E-02	0.130E-02	0.127E-01	0.618E+00	0.484E-01	0.938E+05	1.40
9.50	0.806E-01	0.260E-02	0.911E-02	0.141E-02	0.127E-01	0.618E+00	0.484E-01	0.792E+05	1.40
9.50	0.815E-01	0.266E-02	0.921E-02	0.152E-02	0.127E-01	0.618E+00	0.484E-01	0.670E+05	1.40
9.50	0.824E-01	0.272E-02	0.931E-02	0.164E-02	0.127E-01	0.618E+00	0.484E-01	0.572E+05	1.40
9.50	0.833E-01	0.278E-02	0.940E-02	0.176E-02	0.127E-01	0.618E+00	0.484E-01	0.492E+05	1.40
9.50	0.841E-01	0.284E-02	0.950E-02	0.188E-02	0.127E-01	0.618E+00	0.484E-01	0.426E+05	1.40
9.50	0.861E-01	0.291E-02	0.972E-02	0.201E-02	0.127E-01	0.618E+00	0.484E-01	0.363E+05	1.40
9.50	0.880E-01	0.297E-02	0.992E-02	0.215E-02	0.127E-01	0.618E+00	0.484E-01	0.313E+05	1.40
9.50	0.898E-01	0.302E-02	0.101E-01	0.227E-02	0.127E-01	0.618E+00	0.484E-01	0.273E+05	1.40
9.50	0.915E-01	0.308E-02	0.103E-01	0.240E-02	0.127E-01	0.618E+00	0.484E-01	0.241E+05	1.40
9.50	0.932E-01	0.313E-02	0.105E-01	0.251E-02	0.127E-01	0.618E+00	0.484E-01	0.216E+05	1.40
9.50	0.947E-01	0.317E-02	0.106E-01	0.262E-02	0.127E-01	0.618E+00	0.484E-01	0.195E+05	1.40
9.50	0.961E-01	0.321E-02	0.108E-01	0.272E-02	0.127E-01	0.618E+00	0.484E-01	0.175E+05	1.40
9.50	0.972E-01	0.325E-02	0.109E-01	0.281E-02	0.127E-01	0.618E+00	0.484E-01	0.166E+05	1.40
9.50	0.982E-01	0.327E-02	0.111E-01	0.288E-02	0.127E-01	0.618E+00	0.484E-01	0.155E+05	1.40
9.50	0.990E-01	0.330E-02	0.112E-01	0.294E-02	0.127E-01	0.618E+00	0.484E-01	0.147E+05	1.40
9.50	0.100E+00	0.332E-02	0.113E-01	0.299E-02	0.127E-01	0.618E+00	0.484E-01	0.142E+05	1.40
9.50	0.101E+00	0.334E-02	0.114E-01	0.302E-02	0.127E-01	0.618E+00	0.484E-01	0.138E+05	1.40
9.50	0.102E+00	0.333E-02	0.114E-01	0.303E-02	0.127E-01	0.618E+00	0.484E-01	0.135E+05	1.40
9.50	0.102E+00	0.333E-02	0.115E-01	0.303E-02	0.127E-01	0.618E+00	0.484E-01	0.135E+05	1.40
9.50	0.103E+00	0.333E-02	0.115E-01	0.302E-02	0.127E-01	0.618E+00	0.484E-01	0.136E+05	1.40
9.50	0.103E+00	0.331E-02	0.116E-01	0.298E-02	0.127E-01	0.618E+00	0.484E-01	0.139E+05	1.40
9.50	0.103E+00	0.330E-02	0.116E-01	0.294E-02	0.127E-01	0.618E+00	0.484E-01	0.143E+05	1.40
9.50	0.103E+00	0.327E-02	0.115E-01	0.288E-02	0.127E-01	0.618E+00	0.484E-01	0.150E+05	1.40
9.50	0.103E+00	0.324E-02	0.115E-01	0.280E-02	0.127E-01	0.618E+00	0.484E-01	0.158E+05	1.40
9.50	0.102E+00	0.321E-02	0.115E-01	0.272E-02	0.127E-01	0.618E+00	0.484E-01	0.169E+05	1.40
9.50	0.102E+00	0.317E-02	0.114E-01	0.262E-02	0.127E-01	0.618E+00	0.484E-01	0.182E+05	1.40
9.50	0.101E+00	0.313E-02	0.114E-01	0.252E-02	0.127E-01	0.618E+00	0.484E-01	0.193E+05	1.40
9.50	0.100E+00	0.308E-02	0.113E-01	0.241E-02	0.127E-01	0.618E+00	0.484E-01	0.218E+05	1.40
9.50	0.993E-01	0.303E-02	0.112E-01	0.229E-02	0.127E-01	0.618E+00	0.484E-01	0.242E+05	1.40
9.50	0.986E-01	0.298E-02	0.111E-01	0.217E-02	0.127E-01	0.618E+00	0.484E-01	0.271E+05	1.40
9.50	0.980E-01	0.293E-02	0.111E-01	0.205E-02	0.127E-01	0.618E+00	0.484E-01	0.306E+05	1.40
9.50	0.974E-01	0.287E-02	0.110E-01	0.193E-02	0.127E-01	0.618E+00	0.484E-01	0.348E+05	1.40
9.50	0.967E-01	0.281E-02	0.109E-01	0.181E-02	0.127E-01	0.618E+00	0.484E-01	0.399E+05	1.40
9.50	0.961E-01	0.275E-02	0.108E-01	0.170E-02	0.127E-01	0.618E+00	0.484E-01	0.458E+05	1.40
9.50	0.956E-01	0.269E-02	0.107E-01	0.158E-02	0.127E-01	0.618E+00	0.484E-01	0.529E+05	1.40
9.50	0.952E-01	0.263E-02	0.107E-01	0.148E-02	0.127E-01	0.618E+00	0.484E-01	0.613E+05	1.40
9.50	0.948E-01	0.258E-02	0.107E-01	0.137E-02	0.127E-01	0.618E+00	0.484E-01	0.711E+05	1.40
9.50	0.950E-01	0.254E-02	0.107E-01	0.131E-02	0.127E-01	0.618E+00	0.484E-01	0.825E+05	1.40
9.50	0.964E-01	0.249E-02	0.109E-01	0.123E-02	0.127E-01	0.618E+00	0.484E-01	0.956E+05	1.40
9.50	0.979E-01	0.244E-02	0.110E-01	0.115E-02	0.127E-01	0.618E+00	0.484E-01	0.110E+06	1.40
9.50	0.100E+00	0.240E-02	0.113E-01	0.108E-02	0.127E-01	0.618E+00	0.484E-01	0.126E+06	1.40
9.50	0.103E+00	0.236E-02	0.116E-01	0.102E-02	0.127E-01	0.618E+00	0.484E-01	0.144E+06	1.40
9.50	0.107E+00	0.232E-02	0.120E-01	0.965E-03	0.127E-01	0.618E+00	0.484E-01	0.161E+06	1.40

9.50	0.112E+00	0.228E-02	0.124E-01	0.384E-02	0.127E-01	0.618E+00	0.484E-01	0.178E+06	1.40
9.50	0.120E+00	0.225E-02	0.130E-01	0.378E-02	0.127E-01	0.618E+00	0.484E-01	0.192E+06	1.40
9.50	0.129E+00	0.223E-02	0.13[illegible]E-01	0.374E-02	0.127E-01	0.618E+00	0.484E-01	0.203E+06	1.40
9.50	0.138E+00	0.222E-02	0.144E-01	0.371E-02	0.127E-01	0.618E+00	0.484E-01	0.207E+06	1.40

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CCC                       CCC
CCC   SOLID FUEL RAMJET   CCC
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GEOMETRICAL DATA:

AREF= 0.1245E-01M2 L3= 0.5842E+00M TETP= 9.5

AO/AREF	A1C/AO	A1/AO	A2/AO	A3/AREF	A5/AREF	A6/A5
0.2800	0.8194	0.4700	0.9100	0.4259	0.2600	3.8462

MO	M1C	M6
2.5336	2.3136	2.6646

CONSTANT LOSSES:

PID1= 0.930 PID2= 0.930 PIN= 0.960

INITIAL FLIGHT CONDITIONS:

PO(KG/M2)	TO(K)	ROO(KG/M3)	PTO(KG/M2)	TTO(K)	GA
0.103E+05	0.288E+03	0.122E+01	0.186E+06	0.658E+03	1.400

TIME	MO	AS/AO	WA	WF/WA	M2	M3N	M31	M4	TOTAL PRES. RATIOS 1C/0	12/11	3/2	4/3	6/0	GF	TT4(K)	CF	F(N)	ISP
0.62	2.53	0.518	2.929	6.596	0.299	0.163	0.180	0.391	0.996	0.827	0.961	0.940	0.620	1.25	2258.8	0.242	1370.6	7094.8
1.24	2.54	0.518	2.929	6.570	0.299	0.158	0.173	0.373	0.996	0.827	0.960	0.944	0.619	1.25	2255.0	0.241	1363.8	7097.8
1.87	2.54	0.511	2.769	6.703	0.295	0.151	0.165	0.357	0.996	0.831	0.959	0.949	0.628	1.25	2268.3	0.263	1381.5	7477.9
2.49	2.55	0.504	2.666	6.776	0.292	0.146	0.158	0.345	0.996	0.839	0.959	0.951	0.634	1.25	2272.4	0.274	1377.6	7637.0
3.11	2.55	0.497	2.571	6.854	0.289	0.141	0.152	0.333	0.996	0.844	0.959	0.954	0.637	1.25	2277.5	0.283	1365.0	7744.5
3.73	2.56	0.497	2.477	6.939	0.288	0.137	0.147	0.324	0.996	0.841	0.958	0.956	0.638	1.25	2283.4	0.290	1343.6	7816.2
4.35	2.57	0.497	2.385	7.028	0.288	0.133	0.143	0.315	0.996	0.837	0.958	0.958	0.637	1.25	2290.0	0.297	1317.6	7860.9
4.98	2.58	0.497	2.294	7.123	0.287	0.130	0.140	0.307	0.996	0.832	0.958	0.959	0.635	1.25	2297.2	0.302	1288.3	7884.6
5.60	2.59	0.494	2.205	7.221	0.284	0.126	0.136	0.300	0.996	0.831	0.958	0.961	0.633	1.25	2305.0	0.306	1256.8	7891.6
6.22	2.60	0.494	2.119	7.323	0.284	0.124	0.133	0.294	0.996	0.826	0.957	0.962	0.629	1.25	2312.0	0.310	1222.6	7877.1
6.84	2.61	0.497	2.036	7.430	0.284	0.121	0.131	0.289	0.996	0.816	0.957	0.963	0.624	1.25	2315.1	0.312	1182.2	7822.6
7.47	2.62	0.497	1.955	7.540	0.283	0.119	0.129	0.284	0.996	0.810	0.957	0.964	0.619	1.25	2318.5	0.314	1143.7	7759.9
8.09	2.63	0.497	1.877	7.653	0.283	0.117	0.127	0.280	0.995	0.804	0.957	0.965	0.613	1.25	2322.0	0.316	1104.7	7692.6
8.71	2.64	0.497	1.801	7.769	0.282	0.115	0.125	0.276	0.995	0.793	0.957	0.966	0.607	1.25	2322.2	0.316	1063.3	7599.2
9.33	2.65	0.504	1.728	7.889	0.284	0.113	0.124	0.272	0.995	0.784	0.956	0.967	0.601	1.25	2320.1	0.316	1020.8	7487.1
9.95	2.66	0.504	1.658	8.012	0.283	0.111	0.122	0.269	0.995	0.778	0.956	0.968	0.595	1.25	2317.8	0.315	979.6	7373.9
10.58	2.67	0.504	1.591	8.138	0.282	0.110	0.121	0.266	0.995	0.773	0.956	0.968	0.589	1.25	2315.5	0.315	939.9	7261.1
11.20	2.68	0.511	1.526	8.267	0.285	0.108	0.121	0.263	0.995	0.759	0.955	0.969	0.583	1.25	2313.0	0.314	901.7	7149.0
11.82	2.69	0.511	1.464	8.398	0.284	0.107	0.119	0.261	0.995	0.754	0.955	0.969	0.577	1.25	2305.2	0.312	859.4	6992.1
12.44	2.70	0.511	1.406	8.533	0.284	0.106	0.118	0.258	0.995	0.749	0.955	0.970	0.571	1.25	2295.3	0.309	817.1	6821.7
13.06	2.71	0.518	1.347	8.670	0.286	0.105	0.118	0.256	0.995	0.736	0.954	0.970	0.563	1.25	2285.4	0.305	775.9	6644.8
13.69	2.72	0.518	1.292	8.809	0.285	0.104	0.117	0.254	0.995	0.731	0.954	0.970	0.557	1.26	2275.1	0.302	736.6	6473.6
14.31	2.73	0.525	1.239	8.951	0.288	0.103	0.118	0.253	0.995	0.719	0.953	0.971	0.551	1.26	2264.6	0.299	699.7	6308.2
14.93	2.73	0.525	1.189	9.096	0.288	0.103	0.117	0.251	0.995	0.715	0.953	0.971	0.545	1.26	2252.7	0.295	665.8	6148.2
15.55	2.74	0.532	1.141	9.243	0.290	0.102	0.117	0.250	0.994	0.704	0.952	0.971	0.540	1.26	2240.2	0.293	632.6	6000.3
16.17	2.75	0.532	1.095	9.392	0.290	0.101	0.117	0.248	0.994	0.700	0.952	0.971	0.535	1.26	2226.4	0.291	602.1	5856.7
16.80	2.75	0.532	1.051	9.543	0.290	0.100	0.116	0.247	0.994	0.697	0.952	0.972	0.531	1.26	2212.2	0.288	573.2	5716.6
17.42	2.76	0.539	1.009	9.697	0.292	0.100	0.117	0.246	0.994	0.687	0.951	0.972	0.527	1.26	2197.8	0.286	545.7	5579.7
18.04	2.76	0.539	0.968	9.852	0.292	0.099	0.116	0.245	0.994	0.684	0.951	0.972	0.523	1.26	2183.2	0.284	519.6	5445.9

18.66	2.77	0.539	0.920	10.009	0.292	0.099	0.116	0.244	0.994	0.681	0.951	0.972	0.519	1.26	2168.7	0.282	494.7	5314.0
19.29	2.77	0.542	0.894	10.168	0.293	0.098	0.116	0.244	0.994	0.675	0.951	0.972	0.516	1.26	2151.6	0.279	469.6	5168.6
19.91	2.78	0.546	0.859	10.329	0.295	0.098	0.116	0.243	0.994	0.670	0.951	0.972	0.512	1.26	2134.7	0.275	445.8	5026.8
20.53	2.78	0.546	0.825	10.492	0.294	0.097	0.116	0.242	0.994	0.668	0.951	0.972	0.509	1.26	2117.7	0.273	423.3	4889.1
21.15	2.77	0.546	0.793	10.656	0.294	0.097	0.116	0.242	0.994	0.668	0.951	0.972	0.509	1.27	2100.8	0.272	404.2	4781.6
21.77	2.76	0.546	0.763	10.822	0.295	0.097	0.114	0.241	0.994	0.672	0.950	0.972	0.515	1.27	2084.5	0.276	391.7	4731.8
22.40	2.75	0.539	0.734	10.989	0.292	0.097	0.114	0.241	0.994	0.683	0.951	0.973	0.521	1.27	2068.1	0.280	377.6	4691.0
23.02	2.75	0.539	0.706	11.157	0.292	0.096	0.114	0.240	0.994	0.697	0.951	0.973	0.527	1.27	2051.9	0.284	365.0	4671.3
23.64	2.74	0.532	0.680	11.327	0.290	0.096	0.113	0.240	0.994	0.698	0.952	0.973	0.533	1.27	2036.2	0.288	353.2	4586.3
24.26	2.73	0.532	0.655	11.498	0.290	0.096	0.113	0.239	0.994	0.707	0.952	0.973	0.539	1.27	2020.4	0.292	341.8	4539.5
24.88	2.72	0.525	0.631	11.670	0.287	0.096	0.112	0.239	0.995	0.713	0.953	0.973	0.545	1.27	2004.6	0.296	330.6	4490.7
25.51	2.72	0.525	0.608	11.843	0.288	0.096	0.112	0.239	0.995	0.717	0.952	0.973	0.551	1.27	1988.7	0.300	319.7	4440.6
26.13	2.71	0.518	0.586	12.016	0.285	0.096	0.111	0.239	0.995	0.729	0.953	0.973	0.557	1.28	1972.8	0.303	307.0	4389.0
26.75	2.70	0.518	0.565	12.191	0.286	0.095	0.111	0.238	0.995	0.733	0.953	0.973	0.563	1.28	1956.8	0.307	299.8	4336.4
27.37	2.69	0.511	0.545	12.367	0.283	0.095	0.110	0.239	0.995	0.744	0.954	0.973	0.568	1.28	1940.7	0.310	288.9	4282.9
27.99	2.69	0.511	0.526	12.543	0.283	0.095	0.110	0.238	0.995	0.749	0.954	0.973	0.574	1.28	1924.6	0.313	279.1	4228.6
28.62	2.68	0.508	0.508	12.720	0.282	0.095	0.109	0.238	0.995	0.756	0.954	0.973	0.580	1.28	1909.3	0.317	270.1	4179.3
29.24	2.67	0.504	0.491	12.898	0.281	0.095	0.109	0.238	0.995	0.764	0.954	0.973	0.587	1.28	1895.6	0.321	262.2	4142.4
29.86	2.66	0.497	0.474	13.075	0.279	0.095	0.108	0.238	0.995	0.776	0.955	0.973	0.593	1.28	1881.9	0.325	254.4	4104.2
30.48	2.66	0.497	0.458	13.254	0.279	0.095	0.108	0.238	0.995	0.780	0.955	0.973	0.599	1.28	1868.1	0.329	247.0	4065.2
31.11	2.65	0.491	0.443	13.432	0.277	0.095	0.107	0.238	0.995	0.792	0.956	0.973	0.606	1.28	1854.4	0.333	239.7	4025.7
31.73	2.64	0.491	0.429	13.611	0.277	0.095	0.107	0.238	0.995	0.796	0.956	0.973	0.612	1.28	1840.7	0.337	232.7	3995.7
32.35	2.63	0.487	0.415	13.789	0.276	0.095	0.107	0.238	0.995	0.804	0.956	0.973	0.618	1.29	1827.1	0.341	225.8	3945.3
32.97	2.63	0.484	0.402	13.968	0.275	0.095	0.107	0.238	0.995	0.812	0.956	0.973	0.624	1.29	1813.4	0.344	219.2	3914.6
33.59	2.62	0.484	0.389	14.146	0.276	0.095	0.107	0.238	0.995	0.816	0.956	0.973	0.630	1.29	1799.9	0.348	212.9	3863.8
34.22	2.61	0.477	0.377	14.325	0.273	0.095	0.106	0.238	0.995	0.828	0.957	0.973	0.636	1.29	1786.3	0.351	205.7	3822.9
34.84	2.61	0.477	0.366	14.503	0.274	0.095	0.106	0.238	0.995	0.832	0.957	0.973	0.642	1.29	1772.8	0.354	200.7	3781.9
35.46	2.60	0.473	0.355	14.680	0.273	0.095	0.106	0.238	0.996	0.840	0.957	0.973	0.648	1.29	1759.4	0.357	195.0	3740.9

TETA= 45.0 TIME OF BURNING= 35.46 SEC RANGE OF BURNING=0.2385E+05 KM HEIGHT OF BURNING=0.1730E+05 KM

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RAMJET TRAJECTORY

LPR	WPR	A30	A0/AR	A5/AF	L3	U0	U	WR	TOEV
0.155E+01	0.475E+02	0.530E-02	0.280E+00	0.260E+03	0.584E+00	0.762E+03	0.863E+03	0.199E+01	0.124E+03

TI	X3	Y3	TETA	MO	PO	RHOA	TO	MUA	WPR	DRAG	THRUST
0.622E+00	0.759E+03	0.755E+03	0.447E+02	2.534	0.103E+05	0.122E+01	0.288E+03	0.179E-04	47.5	1381.3	1370.6
0.311E+01	0.228E+04	0.223E+04	0.435E+02	2.552	0.832E+04	0.104E+01	0.276E+03	0.172E-04	47.0	1143.9	1365.0
0.560E+01	0.383E+04	0.366E+04	0.423E+02	2.587	0.689E+04	0.886E+00	0.267E+03	0.168E-04	46.7	973.3	1256.8
0.809E+01	0.541E+04	0.506E+04	0.411E+02	2.630	0.559E+04	0.753E+00	0.257E+03	0.164E-04	46.5	826.8	1104.7
0.106E+02	0.701E+04	0.647E+04	0.398E+02	2.672	0.470E+04	0.638E+00	0.248E+03	0.160E-04	46.3	700.1	939.9
0.131E+02	0.864E+04	0.774E+04	0.386E+02	2.710	0.389E+04	0.540E+00	0.240E+03	0.157E-04	46.1	564.3	775.3
0.156E+02	0.103E+05	0.901E+04	0.372E+02	2.742	0.323E+04	0.454E+00	0.231E+03	0.153E-04	46.0	475.8	632.6
0.180E+02	0.120E+05	0.102E+05	0.359E+02	2.765	0.269E+04	0.399E+00	0.224E+03	0.150E-04	45.9	401.0	519.6
0.205E+02	0.136E+05	0.114E+05	0.345E+02	2.778	0.225E+04	0.332E+00	0.217E+03	0.141E-04	45.9	337.4	423.3
0.230E+02	0.153E+05	0.125E+05	0.331E+02	2.746	0.190E+04	0.284E+00	0.217E+03	0.141E-04	45.9	289.3	365.0
0.255E+02	0.170E+05	0.134E+05	0.316E+02	2.715	0.162E+04	0.245E+00	0.217E+03	0.141E-04	45.8	247.7	319.7
0.280E+02	0.187E+05	0.146E+05	0.301E+02	2.695	0.138E+04	0.212E+00	0.217E+03	0.141E-04	45.8	214.0	275.1
0.305E+02	0.204E+05	0.156E+05	0.286E+02	2.656	0.119E+04	0.185E+00	0.217E+03	0.141E-04	45.8	186.1	247.0
0.330E+02	0.221E+05	0.165E+05	0.270E+02	2.628	0.104E+04	0.163E+00	0.217E+03	0.141E-04	45.8	173.0	219.2
0.355E+02	0.239E+05	0.173E+05	0.253E+02	2.601	0.909E+03	0.144E+00	0.217E+03	0.141E-04	45.8	147.7	195.0
0.379E+02	0.256E+05	0.181E+05	0.237E+02	2.550	0.814E+03	0.129E+00	0.217E+03	0.141E-04	45.8	126.0	0.0
0.404E+02	0.273E+05	0.188E+05	0.219E+02	2.495	0.718E+03	0.115E+00	0.217E+03	0.141E-04	45.8	111.0	0.0
0.429E+02	0.290E+05	0.194E+05	0.201E+02	2.445	0.648E+03	0.105E+00	0.217E+03	0.141E-04	45.8	98.9	0.0
0.454E+02	0.306E+05	0.200E+05	0.183E+02	2.400	0.590E+03	0.964E-01	0.217E+03	0.141E-04	45.8	89.0	0.0
0.479E+02	0.323E+05	0.205E+05	0.164E+02	2.359	0.543E+03	0.891E-01	0.217E+03	0.141E-04	45.8	81.0	0.0
0.504E+02	0.339E+05	0.210E+05	0.144E+02	2.321	0.515E+03	0.832E-01	0.217E+03	0.141E-04	45.8	74.4	0.0
0.529E+02	0.356E+05	0.213E+05	0.124E+02	2.287	0.474E+03	0.784E-01	0.217E+03	0.141E-04	45.8	69.0	0.0
0.554E+02	0.372E+05	0.217E+05	0.104E+02	2.256	0.450E+03	0.746E-01	0.217E+03	0.141E-04	45.8	64.7	0.0
0.579E+02	0.389E+05	0.219E+05	0.829E+01	2.229	0.430E+03	0.716E-01	0.217E+03	0.141E-04	45.8	61.2	0.0
0.603E+02	0.405E+05	0.221E+05	0.617E+01	2.206	0.416E+03	0.694E-01	0.217E+03	0.141E-04	45.8	58.6	0.0
0.628E+02	0.421E+05	0.223E+05	0.402E+01	2.186	0.406E+03	0.678E-01	0.217E+03	0.141E-04	45.8	56.7	0.0
0.653E+02	0.437E+05	0.223E+05	0.195E+01	2.169	0.401E+03	0.669E-01	0.217E+03	0.141E-04	45.8	55.5	0.0
0.678E+02	0.452E+05	0.223E+05	-0.344E+00	2.156	0.399E+03	0.666E-01	0.217E+03	0.141E-04	45.8	54.8	0.0
0.703E+02	0.468E+05	0.223E+05	-0.255E+01	2.146	0.401E+03	0.669E-01	0.217E+03	0.141E-04	45.8	54.7	0.0
0.728E+02	0.484E+05	0.222E+05	-0.476E+01	2.139	0.407E+03	0.679E-01	0.217E+03	0.141E-04	45.8	55.1	0.0
0.753E+02	0.500E+05	0.220E+05	-0.697E+01	2.135	0.417E+03	0.694E-01	0.217E+03	0.141E-04	45.8	56.1	0.0
0.778E+02	0.515E+05	0.218E+05	-0.917E+01	2.134	0.431E+03	0.717E-01	0.217E+03	0.141E-04	45.8	57.7	0.0
0.803E+02	0.530E+05	0.215E+05	-0.114E+02	2.136	0.450E+03	0.747E-01	0.217E+03	0.141E-04	45.8	59.9	0.0
0.827E+02	0.546E+05	0.212E+05	-0.135E+02	2.141	0.474E+03	0.784E-01	0.217E+03	0.141E-04	45.8	62.8	0.0
0.852E+02	0.561E+05	0.208E+05	-0.157E+02	2.148	0.504E+03	0.831E-01	0.217E+03	0.141E-04	45.8	66.5	0.0
0.877E+02	0.576E+05	0.203E+05	-0.178E+02	2.157	0.541E+03	0.888E-01	0.217E+03	0.141E-04	45.8	71.0	0.0
0.902E+02	0.591E+05	0.198E+05	-0.199E+02	2.168	0.586E+03	0.957E-01	0.217E+03	0.141E-04	45.8	76.5	0.0
0.927E+02	0.606E+05	0.192E+05	-0.219E+02	2.181	0.641E+03	0.104E+00	0.217E+03	0.141E-04	45.8	83.1	0.0
0.952E+02	0.621E+05	0.186E+05	-0.239E+02	2.196	0.706E+03	0.114E+00	0.217E+03	0.141E-04	45.8	91.0	0.0
0.977E+02	0.636E+05	0.179E+05	-0.259E+02	2.212	0.785E+03	0.126E+00	0.217E+03	0.141E-04	45.8	100.5	0.0
0.100E+03	0.650E+05	0.171E+05	-0.278E+02	2.228	0.879E+03	0.140E+00	0.217E+03	0.141E-04	45.8	111.8	0.0
0.103E+03	0.665E+05	0.162E+05	-0.297E+02	2.244	0.993E+03	0.155E+00	0.217E+03	0.141E-04	45.8	125.1	0.0
0.105E+03	0.679E+05	0.151E+05	-0.315E+02	2.261	0.113E+04	0.176E+00	0.217E+03	0.141E-04	45.8	141.1	0.0
0.108E+03	0.693E+05	0.144E+05	-0.332E+02	2.277	0.129E+04	0.201E+00	0.217E+03	0.141E-04	45.8	159.8	0.0
0.110E+03	0.707E+05	0.136E+05	-0.350E+02	2.291	0.149E+04	0.224E+00	0.217E+03	0.141E-04	45.8	181.9	0.0
0.113E+03	0.721E+05	0.126E+05	-0.366E+02	2.303	0.173E+04	0.261E+00	0.217E+03	0.141E-04	45.8	207.6	0.0
0.115E+03	0.734E+05	0.116E+05	-0.383E+02	2.313	0.203E+04	0.301E+00	0.217E+03	0.141E-04	45.8	237.6	0.0
0.118E+03	0.748E+05	0.105E+05	-0.399E+02	2.310	0.238E+04	0.348E+00	0.219E+03	0.146E-04	45.8	273.8	0.0
0.120E+03	0.760E+05	0.939E+04	-0.414E+02	2.275	0.280E+04	0.403E+00	0.225E+03	0.151E-04	45.8	316.3	0.0
0.123E+03	0.773E+05	0.824E+04	-0.430E+02	2.233	0.331E+04	0.468E+00	0.233E+03	0.154E-04	45.8	364.6	0.0
0.125E+03	0.785E+05	0.707E+04	-0.445E+02	2.185	0.392E+04	0.544E+00	0.240E+03	0.157E-04	45.8	419.1	0.0
0.128E+03	0.797E+05	0.587E+04	-0.460E+02	2.129	0.464E+04	0.631E+00	0.248E+03	0.160E-04	45.8	480.4	0.0
0.130E+03	0.808E+05	0.467E+04	-0.474E+02	2.065	0.549E+04	0.730E+00	0.256E+03	0.163E-04	45.8	546.0	0.0
0.133E+03	0.819E+05	0.346E+04	-0.489E+02	1.992	0.648E+04	0.842E+00	0.264E+03	0.167E-04	45.8	618.7	0.0
0.135E+03	0.829E+05	0.226E+04	-0.503E+02	1.908	0.763E+04	[illegible]	0.272E+03	0.170E-04	45.8	712.1	0.0
0.137E+03	0.839E+05	0.107E+04	-0.518E+02	1.818	0.895E+04	[illegible]	0.280E+03	0.174E-04	45.8	778.5	0.0
0.140E+03	0.848E+05	-0.963E+02	-0.532E+02	1.722	0.111E+05	0.121E+01	0.287E+03	0.178E-04	45.8	827.1	0.0

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RAMJET TRAJECTORY

(DRAG COEF.)

LPR	WPR	A30	A0/AR	A5/AR	L3	U0	U	WR	TOEV
0.155E+01	0.475E+02	0.530E-02	0.280E+00	0.260E+00	0.584E+00	0.762E+03	0.863E+03	0.199E+01	0.124E+03

TETP	CDN	CDS	CDWW	CDWF	APR	SPR	CWW	Q	XMO
9.50	0.864E-01	0.210E-02	0.974E-02	0.346E-02	0.127E-01	0.618E+00	0.484E-01	0.456E+06	1.40
9.50	0.857E-01	0.214E-02	0.967E-02	0.355E-02	0.127E-01	0.618E+00	0.484E-01	0.375E+06	1.40
9.50	0.845E-01	0.218E-02	0.955E-02	0.363E-02	0.127E-01	0.618E+00	0.484E-01	0.318E+06	1.40
9.50	0.832E-01	0.223E-02	0.939E-02	0.373E-02	0.127E-01	0.618E+00	0.484E-01	0.270E+06	1.40
9.50	0.819E-01	0.227E-02	0.925E-02	0.383E-02	0.127E-01	0.618E+00	0.484E-01	0.228E+06	1.40
9.50	0.808E-01	0.232E-02	0.913E-02	0.978E-03	0.127E-01	0.618E+00	0.484E-01	0.191E+06	1.40
9.50	0.799E-01	0.238E-02	0.903E-02	0.105E-02	0.127E-01	0.618E+00	0.484E-01	0.160E+06	1.40
9.50	0.792E-01	0.243E-02	0.896E-02	0.114E-02	0.127E-01	0.618E+00	0.484E-01	0.134E+06	1.40
9.50	0.788E-01	0.247E-02	0.892E-02	0.123E-02	0.127E-01	0.618E+00	0.484E-01	0.112E+06	1.40
9.50	0.797E-01	0.253E-02	0.901E-02	0.130E-02	0.127E-01	0.618E+00	0.484E-01	0.933E+05	1.40
9.50	0.806E-01	0.260E-02	0.911E-02	0.141E-02	0.127E-01	0.618E+00	0.484E-01	0.790E+05	1.40
9.50	0.815E-01	0.266E-02	0.921E-02	0.152E-02	0.127E-01	0.618E+00	0.484E-01	0.670E+05	1.40
9.50	0.824E-01	0.272E-02	0.931E-02	0.164E-02	0.127E-01	0.618E+00	0.484E-01	0.572E+05	1.40
9.50	0.833E-01	0.278E-02	0.940E-02	0.176E-02	0.127E-01	0.618E+00	0.484E-01	0.492E+05	1.40
9.50	0.841E-01	0.284E-02	0.950E-02	0.188E-02	0.127E-01	0.618E+00	0.484E-01	0.426E+05	1.40
9.50	0.858E-01	0.291E-02	0.968E-02	0.201E-02	0.127E-01	0.618E+00	0.484E-01	0.365E+05	1.40
9.50	0.877E-01	0.297E-02	0.989E-02	0.214E-02	0.127E-01	0.618E+00	0.484E-01	0.315E+05	1.40
9.50	0.895E-01	0.302E-02	0.101E-01	0.227E-02	0.127E-01	0.618E+00	0.484E-01	0.275E+05	1.40
9.50	0.912E-01	0.308E-02	0.103E-01	0.240E-02	0.127E-01	0.618E+00	0.484E-01	0.243E+05	1.40
9.50	0.928E-01	0.313E-02	0.104E-01	0.251E-02	0.127E-01	0.618E+00	0.484E-01	0.217E+05	1.40
9.50	0.944E-01	0.317E-02	0.106E-01	0.262E-02	0.127E-01	0.618E+00	0.484E-01	0.196E+05	1.40
9.50	0.958E-01	0.321E-02	0.108E-01	0.272E-02	0.127E-01	0.618E+00	0.484E-01	0.179E+05	1.40
9.50	0.969E-01	0.325E-02	0.109E-01	0.281E-02	0.127E-01	0.618E+00	0.484E-01	0.166E+05	1.40
9.50	0.979E-01	0.327E-02	0.110E-01	0.288E-02	0.127E-01	0.618E+00	0.484E-01	0.156E+05	1.40
9.50	0.988E-01	0.330E-02	0.112E-01	0.294E-02	0.127E-01	0.618E+00	0.484E-01	0.148E+05	1.40
9.50	0.998E-01	0.332E-02	0.113E-01	0.299E-02	0.127E-01	0.618E+00	0.484E-01	0.142E+05	1.40
9.50	0.101E+00	0.333E-02	0.113E-01	0.302E-02	0.127E-01	0.618E+00	0.484E-01	0.138E+05	1.40
9.50	0.102E+00	0.333E-02	0.114E-01	0.304E-02	0.127E-01	0.618E+00	0.484E-01	0.135E+05	1.40
9.50	0.102E+00	0.333E-02	0.115E-01	0.304E-02	0.127E-01	0.618E+00	0.484E-01	0.135E+05	1.40
9.50	0.103E+00	0.333E-02	0.115E-01	0.302E-02	0.127E-01	0.618E+00	0.484E-01	0.136E+05	1.40
9.50	0.103E+00	0.332E-02	0.115E-01	0.299E-02	0.127E-01	0.618E+00	0.484E-01	0.138E+05	1.40
9.50	0.103E+00	0.330E-02	0.115E-01	0.294E-02	0.127E-01	0.618E+00	0.484E-01	0.142E+05	1.40
9.50	0.103E+00	0.327E-02	0.115E-01	0.288E-02	0.127E-01	0.618E+00	0.484E-01	0.149E+05	1.40
9.50	0.102E+00	0.325E-02	0.115E-01	0.281E-02	0.127E-01	0.618E+00	0.484E-01	0.157E+05	1.40
9.50	0.102E+00	0.321E-02	0.115E-01	0.273E-02	0.127E-01	0.618E+00	0.484E-01	0.168E+05	1.40
9.50	0.102E+00	0.317E-02	0.114E-01	0.263E-02	0.127E-01	0.618E+00	0.484E-01	0.191E+05	1.40
9.50	0.101E+00	0.313E-02	0.114E-01	0.253E-02	0.127E-01	0.618E+00	0.484E-01	0.197E+05	1.40
9.50	0.100E+00	0.309E-02	0.113E-01	0.242E-02	0.127E-01	0.618E+00	0.484E-01	0.216E+05	1.40
9.50	0.992E-01	0.304E-02	0.112E-01	0.230E-02	0.127E-01	0.618E+00	0.484E-01	0.240E+05	1.40
9.50	0.986E-01	0.298E-02	0.111E-01	0.218E-02	0.127E-01	0.618E+00	0.484E-01	0.269E+05	1.40
9.50	0.980E-01	0.293E-02	0.111E-01	0.206E-02	0.127E-01	0.618E+00	0.484E-01	0.303E+05	1.40
9.50	0.974E-01	0.287E-02	0.110E-01	0.194E-02	0.127E-01	0.619E+00	0.484E-01	0.344E+05	1.40
9.50	0.967E-01	0.282E-02	0.109E-01	0.182E-02	0.127E-01	0.618E+00	0.484E-01	0.394E+05	1.40
9.50	0.962E-01	0.276E-02	0.108E-01	0.171E-02	0.127E-01	0.618E+00	0.484E-01	0.453E+05	1.40
9.50	0.956E-01	0.270E-02	0.107E-01	0.159E-02	0.127E-01	0.618E+00	0.484E-01	0.523E+05	1.40
9.50	0.952E-01	0.264E-02	0.107E-01	0.148E-02	0.127E-01	0.618E+00	0.484E-01	0.606E+05	1.40
9.50	0.949E-01	0.259E-02	0.107E-01	0.138E-02	0.127E-01	0.619E+00	0.484E-01	0.704E+05	1.40
9.50	0.949E-01	0.254E-02	0.107E-01	0.131E-02	0.127E-01	0.618E+00	0.484E-01	0.817E+05	1.40
9.50	0.962E-01	0.249E-02	0.108E-01	0.123E-02	0.127E-01	0.618E+00	0.484E-01	0.947E+05	1.40
9.50	0.978E-01	0.244E-02	0.110E-01	0.116E-02	0.127E-01	0.618E+00	0.484E-01	0.109E+06	1.40
9.50	0.999E-01	0.241E-02	0.113E-01	0.109E-02	0.127E-01	0.618E+00	0.484E-01	0.125E+06	1.40
9.50	0.103E+00	0.236E-02	0.116E-01	0.102E-02	0.127E-01	0.618E+00	0.484E-01	0.142E+06	1.40
9.50	0.107E+00	0.232E-02	0.119E-01	0.968E-03	0.127E-01	0.618E+00	0.484E-01	0.160E+06	1.40

9.50	0.111E+00	0.228E-02	0.124E-01	0.384E-02	0.127E-01	0.618E+00	0.484E-01	0.177E+06	1.40
9.50	0.119E+00	0.226E-02	0.129E-01	0.379E-02	0.127E-01	0.618E+00	0.484E-01	0.192E+06	1.40
9.50	0.128E+00	0.223E-02	0.136E-01	0.374E-02	0.127E-01	0.618E+00	0.484E-01	0.203E+06	1.40
9.50	0.137E+00	0.222E-02	0.144E-01	0.371E-02	0.127E-01	0.618E+00	0.484E-01	0.207E+06	1.40

FILE: CMB D ' A NAVAL POSTGRADUATE SCHOOL PAGE 001

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CCCCCCCCCCCCCCCCCCCCCCCCCCCCC
CCC                       CCC
CCC   SOLID FUEL RAMJET   CCC
CCC                       CCC
CCCCCCCCCCCCCCCCCCCCCCCCCCCCC
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GEOMETRICAL DATA:

AREF= 0.1245E-01M2   L3= 0.5842E+00M   TETP= 9.5

AO/AREF	A1C/AO	A1/AO	A2/AO	A3/AREF	A5/AREF	A6/A5
0.2800	0.8099	0.4700	0.8269	0.4700	0.2600	3.8462

MO	M1C	M6
2.6144	2.3834	2.6656

CONSTANT LOSSES:

PID1= 0.930   PID2= 0.930   PIN= 0.960

INITIAL FLIGHT CONDITIONS:

PO(KG/M2)	TO(K)	RO0(KG/M3)	PTO(KG/M2)	TTO(K)	GA
0.103E+05	0.288E+03	0.122E+01	0.211E+06	0.682E+03	1.400

TIME	MO	AS/AO	WA	WF/WA	M2	M3N	M3T	M4	TOTAL PRES. RATIOS 1C/0	12/11	3/2	4/3	6/0	GF	TT4(K)	CF	F(N)	ISP
0.64	2.61	0.559	2.929	6.532	0.348	0.152	0.173	0.348	0.995	0.739	0.939	0.951	0.546	1.25	2261.8	0.193	1162.9	6079.3
1.28	2.61	0.559	2.929	6.508	0.348	0.147	0.167	0.334	0.995	0.739	0.938	0.954	0.546	1.25	2258.4	0.192	1156.8	6069.7
1.93	2.60	0.542	2.748	6.652	0.337	0.141	0.157	0.321	0.995	0.757	0.943	0.957	0.563	1.25	2272.9	0.220	1217.9	6661.2
2.57	2.60	0.531	2.649	6.732	0.334	0.136	0.150	0.311	0.996	0.774	0.940	0.959	0.577	1.25	2276.9	0.237	1242.3	6966.8
3.21	2.60	0.526	2.549	6.818	0.331	0.131	0.145	0.302	0.996	0.782	0.941	0.961	0.587	1.25	2281.2	0.251	1247.4	7178.2
3.85	2.60	0.515	2.450	6.909	0.325	0.127	0.139	0.294	0.996	0.794	0.942	0.963	0.593	1.25	2286.7	0.262	1241.2	7331.5
4.49	2.61	0.515	2.354	7.005	0.325	0.124	0.135	0.286	0.996	0.793	0.942	0.965	0.597	1.25	2293.0	0.271	1227.0	7441.6
5.14	2.61	0.509	2.259	7.106	0.322	0.121	0.131	0.280	0.996	0.797	0.942	0.966	0.599	1.25	2300.1	0.279	1207.1	7518.3
5.78	2.62	0.509	2.168	7.212	0.321	0.118	0.129	0.274	0.995	0.793	0.942	0.967	0.600	1.25	2307.8	0.286	1183.1	7568.7
6.42	2.63	0.503	2.079	7.321	0.317	0.115	0.125	0.265	0.995	0.796	0.943	0.968	0.599	1.25	2315.1	0.292	1155.2	7591.0
7.06	2.64	0.503	1.993	7.434	0.317	0.113	0.123	0.265	0.995	0.791	0.943	0.969	0.597	1.25	2318.0	0.296	1120.6	7564.2
7.70	2.65	0.503	1.910	7.550	0.316	0.111	0.121	0.261	0.995	0.787	0.943	0.970	0.594	1.25	2321.3	0.299	1095.0	7524.2
8.35	2.66	0.503	1.830	7.671	0.315	0.109	0.119	0.257	0.995	0.782	0.943	0.970	0.590	1.25	2324.7	0.302	1049.3	7475.9
8.99	2.67	0.503	1.753	7.794	0.314	0.107	0.117	0.254	0.995	0.776	0.943	0.971	0.586	1.25	2323.8	0.303	1002.7	7390.7
9.63	2.68	0.509	1.679	7.921	0.316	0.105	0.117	0.251	0.995	0.765	0.942	0.972	0.581	1.25	2321.3	0.304	969.5	7290.2
10.27	2.69	0.509	1.608	8.051	0.316	0.104	0.115	0.248	0.995	0.760	0.942	0.972	0.576	1.25	2318.9	0.305	929.4	7187.3
10.91	2.69	0.509	1.540	8.184	0.315	0.103	0.114	0.245	0.995	0.755	0.942	0.973	0.571	1.25	2316.1	0.305	897.6	7093.1
11.56	2.70	0.509	1.475	8.320	0.314	0.101	0.113	0.243	0.995	0.750	0.942	0.973	0.566	1.25	2312.3	0.305	855.9	6968.7
12.20	2.71	0.515	1.412	8.458	0.316	0.100	0.113	0.241	0.995	0.739	0.941	0.973	0.560	1.25	2302.1	0.302	812.1	6799.4
12.84	2.72	0.515	1.352	8.600	0.316	0.099	0.112	0.239	0.995	0.734	0.941	0.974	0.555	1.25	2291.6	0.300	771.2	6632.1
13.48	2.73	0.520	1.295	8.744	0.318	0.098	0.112	0.237	0.995	0.723	0.940	0.974	0.548	1.26	2281.0	0.296	731.3	6458.4
14.12	2.74	0.520	1.240	8.891	0.317	0.097	0.111	0.236	0.995	0.719	0.941	0.974	0.542	1.26	2270.0	0.293	691.5	6290.0
14.77	2.75	0.526	1.188	9.041	0.320	0.097	0.111	0.234	0.994	0.709	0.940	0.974	0.537	1.26	2258.8	0.290	658.3	6127.0
15.41	2.75	0.526	1.138	9.193	0.319	0.096	0.110	0.233	0.994	0.705	0.940	0.975	0.532	1.26	2245.6	0.288	624.9	5973.7
16.05	2.76	0.531	1.090	9.348	0.322	0.095	0.111	0.232	0.994	0.695	0.939	0.975	0.528	1.26	2231.2	0.286	593.8	5827.7
16.69	2.76	0.531	1.045	9.505	0.321	0.095	0.110	0.231	0.994	0.692	0.939	0.975	0.523	1.26	2216.5	0.283	564.5	5685.2
17.33	2.77	0.531	1.001	9.664	0.321	0.094	0.110	0.230	0.994	[illegible]	0.939	0.975	0.519	1.26	2201.6	0.281	536.6	5545.9
17.97	2.77	0.537	0.960	9.825	0.324	0.093	0.110	0.227	0.994	0.681	0.938	0.975	0.516	1.26	2186.3	0.279	510.1	5409.7
18.62	2.78	0.537	0.920	9.988	0.323	0.093	0.111	0.228	0.994	0.678	0.938	0.975	0.512	1.26	2170.9	0.277	485.0	5276.4

19.26	2.78	0.537	0.88310.153	0.323	0.092	0.109	0.228	0.994	0.676	0.938	0.975	0.509	1.26	2153.6	0.274	459.7	5129.1
19.90	2.79	0.542	0.84710.320	0.326	0.092	0.110	0.227	0.994	0.668	0.937	0.976	0.505	1.26	2136.1	0.271	435.6	4984.0
20.54	2.78	0.542	0.81310.489	0.325	0.092	0.109	0.226	0.994	0.666	0.937	0.976	0.502	1.26	2118.3	0.268	412.9	4863.0
21.18	2.77	0.542	0.78010.660	0.326	0.091	0.109	0.226	0.994	0.668	0.937	0.976	0.506	1.27	2101.2	0.271	396.6	4768.1
21.83	2.77	0.537	0.74910.832	0.323	0.091	0.108	0.225	0.994	0.678	0.938	0.976	0.512	1.27	2084.3	0.275	382.9	4717.9
22.47	2.76	0.537	0.72011.006	0.324	0.091	0.108	0.225	0.994	0.682	0.938	0.976	0.518	1.27	2067.2	0.279	367.6	4665.4
23.11	2.75	0.531	0.69211.181	0.321	0.091	0.107	0.225	0.994	0.692	0.938	0.976	0.524	1.27	2050.4	0.283	356.9	4615.4
23.75	2.74	0.526	0.66511.357	0.319	0.091	0.106	0.224	0.994	0.703	0.939	0.976	0.531	1.27	2034.1	0.288	345.0	4568.9
24.39	2.73	0.526	0.63911.535	0.320	0.090	0.107	0.224	0.994	0.707	0.939	0.976	0.537	1.27	2017.7	0.292	333.4	4520.3
25.04	2.73	0.520	0.61511.714	0.317	0.090	0.106	0.224	0.995	0.717	0.940	0.976	0.544	1.27	2001.3	0.296	322.1	4469.7
25.68	2.72	0.515	0.59211.894	0.315	0.090	0.105	0.224	0.995	0.727	0.941	0.976	0.550	1.28	1984.7	0.300	311.1	4417.6
26.32	2.71	0.515	0.57012.075	0.315	0.090	0.105	0.223	0.995	0.732	0.941	0.976	0.556	1.28	1968.1	0.304	300.4	4364.0
26.96	2.70	0.509	0.54912.257	0.313	0.090	0.104	0.223	0.995	0.742	0.941	0.976	0.562	1.28	1951.5	0.307	291.0	4309.4
27.60	2.69	0.509	0.52912.439	0.314	0.090	0.104	0.223	0.995	0.746	0.941	0.976	0.568	1.28	1934.8	0.310	279.9	4253.8
28.25	2.69	0.503	0.51012.623	0.311	0.090	0.103	0.223	0.995	0.757	0.942	0.976	0.574	1.28	1918.0	0.314	270.2	4197.6
28.89	2.68	0.503	0.49212.807	0.312	0.090	0.104	0.223	0.995	0.761	0.942	0.976	0.581	1.28	1903.2	0.318	261.7	4155.4
29.53	2.67	0.498	0.47412.992	0.310	0.090	0.103	0.223	0.995	0.772	0.943	0.976	0.587	1.28	1888.9	0.322	253.7	4116.3
30.17	2.66	0.492	0.45813.177	0.307	0.090	0.102	0.223	0.995	0.782	0.943	0.976	0.594	1.28	1874.6	0.327	246.0	4076.4
30.81	2.65	0.492	0.44213.362	0.308	0.090	0.102	0.223	0.995	0.787	0.943	0.976	0.601	1.28	1860.4	0.331	238.5	4035.8
31.46	2.65	0.487	0.42713.548	0.306	0.089	0.101	0.223	0.995	0.797	0.944	0.976	0.607	1.28	1846.1	0.335	231.2	3994.6
32.10	2.64	0.481	0.41313.733	0.303	0.089	0.101	0.223	0.995	0.808	0.945	0.976	0.614	1.29	1831.9	0.339	224.2	3952.9
32.74	2.63	0.481	0.39913.919	0.304	0.089	0.101	0.223	0.995	0.812	0.945	0.976	0.620	1.29	1817.7	0.342	217.4	3910.9
33.38	2.63	0.476	0.38614.105	0.302	0.089	0.100	0.223	0.995	0.823	0.945	0.976	0.626	1.29	1803.5	0.346	210.8	3868.7
34.02	2.62	0.476	0.37414.290	0.303	0.089	0.100	0.223	0.995	0.827	0.945	0.976	0.633	1.29	1789.4	0.350	204.5	3826.3
34.67	2.61	0.473	0.36214.476	0.302	0.089	0.100	0.223	0.995	0.834	0.945	0.976	0.639	1.29	1775.3	0.353	198.3	3783.9

TETA= 45.0   TIME OF BURNING= 34.67 SEC   RANGE OF BURNING=0.2342E+05 KM   HEIGHT OF BURNING=0.1719E+05 KM

FILE: TRJ D ; A NAVAL POSTGRADUATE SCHOOL PAGE 001

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RAMJET TRAJECTORY

LPR	WPR	A30	A0/AR	A5/AR	L3	U0	U	WB	TOFV
0.155E+01	0.475E+02	0.585E-02	0.280E+00	0.260E+01	0.584E+00	0.762E+03	0.890E+03	0.252E+01	0.128E+03

TI	X3	Y3	TETA	MO	PO	RHOA	TO	MUA	WPF	DRAG	THRUST
0.642E+00	0.807E+03	0.803E+03	0.447E+02	2.614	0.103E+05	0.122E+01	0.288E+03	0.179E-04	47.5	1444.3	1162.9
0.321E+01	0.241E+04	0.235E+04	0.435E+02	2.601	0.820E+04	0.102E+01	0.276E+03	0.172E-04	47.0	1160.0	1247.4
0.578E+01	0.403E+04	0.385E+04	0.423E+02	2.621	0.673E+04	0.869E+00	0.265E+03	0.167E-04	46.7	969.9	1183.1
0.835E+01	0.567E+04	0.530E+04	0.410E+02	2.657	0.551E+04	0.733E+00	0.256E+03	0.163E-04	46.4	813.5	1045.3
0.109E+02	0.733E+04	0.671E+04	0.397E+02	2.695	0.452E+04	0.617E+00	0.246E+03	0.159E-04	46.3	681.7	892.6
0.135E+02	0.902E+04	0.807E+04	0.384E+02	2.730	0.371E+04	0.519E+00	0.238E+03	0.156E-04	46.1	544.4	731.3
0.160E+02	0.107E+05	0.938E+04	0.371E+02	2.759	0.306E+04	0.437E+00	0.229E+03	0.152E-04	46.0	455.4	593.8
0.186E+02	0.125E+05	0.106E+05	0.357E+02	2.780	0.254E+04	0.369E+00	0.221E+03	0.142E-04	45.9	381.1	485.0
0.212E+02	0.142E+05	0.118E+05	0.342E+02	2.774	0.212E+04	0.313E+00	0.217E+03	0.141E-04	45.9	319.7	396.6
0.238E+02	0.159E+05	0.130E+05	0.327E+02	2.741	0.178E+04	0.267E+00	0.217E+03	0.141E-04	45.9	271.9	345.0
0.263E+02	0.177E+05	0.141E+05	0.312E+02	2.709	0.151E+04	0.230E+00	0.217E+03	0.141E-04	45.8	232.7	300.4
0.289E+02	0.194E+05	0.151E+05	0.297E+02	2.678	0.128E+04	0.198E+00	0.217E+03	0.141E-04	45.8	200.4	261.7
0.315E+02	0.212E+05	0.161E+05	0.280E+02	2.647	0.110E+04	0.173E+00	0.217E+03	0.141E-04	45.8	173.8	231.2
0.340E+02	0.230E+05	0.170E+05	0.264E+02	2.618	0.959E+03	0.151E+00	0.217E+03	0.141E-04	45.8	151.8	204.5
0.366E+02	0.247E+05	0.178E+05	0.247E+02	2.573	0.839E+03	0.134E+00	0.217E+03	0.141E-04	45.8	132.4	0.0
0.392E+02	0.265E+05	0.186E+05	0.229E+02	2.514	0.743E+03	0.119E+00	0.217E+03	0.141E-04	45.8	115.5	0.0
0.417E+02	0.282E+05	0.193E+05	0.211E+02	2.460	0.665E+03	0.108E+00	0.217E+03	0.141E-04	45.8	102.0	0.0
0.443E+02	0.300E+05	0.199E+05	0.192E+02	2.412	0.601E+03	0.980E-01	0.217E+03	0.141E-04	45.8	91.0	0.0
0.469E+02	0.317E+05	0.205E+05	0.173E+02	2.368	0.549E+03	0.900E-01	0.217E+03	0.141E-04	45.8	82.1	0.0
0.494E+02	0.334E+05	0.209E+05	0.152E+02	2.329	0.507E+03	0.835E-01	0.217E+03	0.141E-04	45.8	75.0	0.0
0.520E+02	0.351E+05	0.214E+05	0.132E+02	2.292	0.473E+03	0.783E-01	0.217E+03	0.141E-04	45.8	69.1	0.0
0.546E+02	0.368E+05	0.217E+05	0.111E+02	2.259	0.446E+03	0.741E-01	0.217E+03	0.141E-04	45.8	64.4	0.0
0.571E+02	0.384E+05	0.220E+05	0.895E+01	2.231	0.425E+03	0.708E-01	0.217E+03	0.141E-04	45.8	60.7	0.0
0.597E+02	0.401E+05	0.222E+05	0.677E+01	2.206	0.409E+03	0.683E-01	0.217E+03	0.141E-04	45.8	57.8	0.0
0.623E+02	0.417E+05	0.224E+05	0.455E+01	2.185	0.398E+03	0.666E-01	0.217E+03	0.141E-04	45.8	55.8	0.0
0.648E+02	0.434E+05	0.225E+05	0.230E+01	2.168	0.392E+03	0.655E-01	0.217E+03	0.141E-04	45.8	54.4	0.0
0.674E+02	0.450E+05	0.225E+05	0.427E-01	2.155	0.389E+03	0.651E-01	0.217E+03	0.141E-04	45.8	53.6	0.0
0.700E+02	0.467E+05	0.225E+05	-0.223E+01	2.145	0.391E+03	0.653E-01	0.217E+03	0.141E-04	45.8	53.5	0.0
0.725E+02	0.483E+05	0.224E+05	-0.451E+01	2.138	0.396E+03	0.662E-01	0.217E+03	0.141E-04	45.8	53.9	0.0
0.751E+02	0.499E+05	0.222E+05	-0.679E+01	2.135	0.406E+03	0.677E-01	0.217E+03	0.141E-04	45.8	54.8	0.0
0.777E+02	0.515E+05	0.220E+05	-0.906E+01	2.135	0.420E+03	0.699E-01	0.217E+03	0.141E-04	45.8	56.4	0.0
0.802E+02	0.531E+05	0.217E+05	-0.113E+02	2.137	0.439E+03	0.729E-01	0.217E+03	0.141E-04	45.8	58.7	0.0
0.828E+02	0.547E+05	0.213E+05	-0.135E+02	2.142	0.463E+03	0.767E-01	0.217E+03	0.141E-04	45.8	61.6	0.0
0.854E+02	0.563E+05	0.209E+05	-0.158E+02	2.150	0.494E+03	0.815E-01	0.217E+03	0.141E-04	45.8	65.4	0.0
0.879E+02	0.578E+05	0.204E+05	-0.179E+02	2.160	0.532E+03	0.873E-01	0.217E+03	0.141E-04	45.8	70.0	0.0
0.905E+02	0.594E+05	0.199E+05	-0.201E+02	2.173	0.578E+03	0.944E-01	0.217E+03	0.141E-04	45.8	75.7	0.0
0.931E+02	0.609E+05	0.193E+05	-0.222E+02	2.187	0.634E+03	0.103E+00	0.217E+03	0.141E-04	45.8	82.6	0.0
0.957E+02	0.625E+05	0.186E+05	-0.242E+02	2.203	0.702E+03	0.113E+00	0.217E+03	0.141E-04	45.8	90.3	0.0
0.982E+02	0.640E+05	0.179E+05	-0.262E+02	2.220	0.784E+03	0.126E+00	0.217E+03	0.141E-04	45.8	100.9	0.0
0.101E+03	0.655E+05	0.171E+05	-0.282E+02	2.238	0.883E+03	0.140E+00	0.217E+03	0.141E-04	45.8	112.9	0.0
0.103E+03	0.670E+05	0.162E+05	-0.301E+02	2.255	0.100E+04	0.159E+00	0.217E+03	0.141E-04	45.8	127.2	0.0
0.106E+03	0.684E+05	0.153E+05	-0.319E+02	2.273	0.115E+04	0.179E+00	0.217E+03	0.141E-04	45.8	144.7	0.0
0.108E+03	0.699E+05	0.144E+05	-0.337E+02	2.289	0.133E+04	0.204E+00	0.217E+03	0.141E-04	45.8	164.3	0.0
0.111E+03	0.713E+05	0.134E+05	-0.355E+02	2.304	0.154E+04	0.235E+00	0.217E+03	0.141E-04	45.8	188.1	0.0
0.114E+03	0.727E+05	0.124E+05	-0.372E+02	2.316	0.181E+04	0.271E+00	0.217E+03	0.141E-04	45.8	216.0	0.0
0.116E+03	0.741E+05	0.113E+05	-0.389E+02	2.324	0.212E+04	0.314E+00	0.217E+03	0.141E-04	45.8	248.6	0.0
0.119E+03	0.755E+05	0.101E+05	-0.405E+02	2.308	0.251E+04	0.365E+00	0.221E+03	0.149E-04	45.8	288.9	0.0
0.121E+03	0.768E+05	0.896E+04	-0.421E+02	2.270	0.298E+04	0.426E+00	0.228E+03	0.152E-04	45.8	335.5	0.0
0.124E+03	0.781E+05	0.776E+04	-0.437E+02	2.224	0.354E+04	0.497E+00	0.236E+03	0.155E-04	45.8	388.2	0.0
0.126E+03	0.793E+05	0.651E+04	-0.452E+02	2.170	0.422E+04	0.581E+00	0.243E+03	0.158E-04	45.8	448.0	0.0
0.129E+03	0.805E+05	0.520E+04	-0.467E+02	2.108	0.503E+04	0.677E+00	0.251E+03	0.161E-04	45.8	514.3	0.0
0.132E+03	0.817E+05	0.403E+04	-0.482E+02	2.037	0.598E+04	0.786E+00	0.260E+03	0.165E-04	45.8	583.8	0.0
0.134E+03	0.828E+05	0.278E+04	-0.497E+02	1.955	0.719E+04	0.907E+00	0.268E+03	0.169E-04	45.8	657.8	0.0
0.137E+03	0.838E+05	0.155E+04	-0.512E+02	1.861	0.833E+04	0.104E+01	0.276E+03	0.172E-04	45.8	756.1	0.0
0.139E+03	0.847E+05	0.329E+03	-0.527E+02	1.766	0.967E+04	0.117E+01	0.284E+03	0.177E-04	45.8	816.2	0.0
0.141E+03	0.852E+05	-0.269E+03	-0.534E+02	1.716	0.103E+05	0.123E+01	0.288E+03	0.179E-04	45.8	834.7	0.0

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RAMJET TRAJECTORY

(DRAG COFF.)

LPR	WPR	A30	AO/AR	A5/AR	L3	UO	U	WB	TOFV
0.155E+01	0.475E+02	0.585E-02	0.280E+00	0.260E+03	0.584E+00	0.762E+03	0.890E+03	0.252E+01	0.128E+03

TETP	CDN	CDS	CDWW	CDWF	APP	SPR	SWW	Q	XMO
9.50	0.837E-01	0.209E-02	0.945E-02	0.344E-02	0.127E-01	0.618E+00	0.484E-01	0.485E+06	1.40
9.50	0.841E-01	0.214E-02	0.950E-02	0.354E-02	0.127E-01	0.618E+00	0.484E-01	0.384E+06	1.40
9.50	0.835E-01	0.218E-02	0.943E-02	0.364E-02	0.127E-01	0.618E+00	0.484E-01	0.319E+06	1.40
9.50	0.824E-01	0.223E-02	0.930E-02	0.374E-02	0.127E-01	0.618E+00	0.484E-01	0.266E+06	1.40
9.50	0.813E-01	0.229E-02	0.918E-02	0.384E-02	0.127E-01	0.618E+00	0.484E-01	0.222E+06	1.40
9.50	0.802E-01	0.234E-02	0.906E-02	0.994E-03	0.127E-01	0.618E+00	0.484E-01	0.185E+06	1.40
9.50	0.794E-01	0.239E-02	0.897E-02	0.108E-02	0.127E-01	0.618E+00	0.484E-01	0.153E+06	1.40
9.50	0.788E-01	0.245E-02	0.891E-02	0.116E-02	0.127E-01	0.618E+00	0.484E-01	0.127E+06	1.40
9.50	0.789E-01	0.249E-02	0.893E-02	0.124E-02	0.127E-01	0.618E+00	0.484E-01	0.105E+06	1.40
9.50	0.796E-01	0.256E-02	0.903E-02	0.135E-02	0.127E-01	0.618E+00	0.484E-01	0.879E+05	1.40
9.50	0.808E-01	0.262E-02	0.913E-02	0.146E-02	0.127E-01	0.618E+00	0.484E-01	0.737E+05	1.40
9.50	0.818E-01	0.269E-02	0.924E-02	0.158E-02	0.127E-01	0.618E+00	0.484E-01	0.622E+05	1.40
9.50	0.827E-01	0.275E-02	0.934E-02	0.170E-02	0.127E-01	0.618E+00	0.484E-01	0.529E+05	1.40
9.50	0.835E-01	0.282E-02	0.944E-02	0.183E-02	0.127E-01	0.618E+00	0.484E-01	0.454E+05	1.40
9.50	0.850E-01	0.288E-02	0.960E-02	0.196E-02	0.127E-01	0.618E+00	0.484E-01	0.387E+05	1.40
9.50	0.870E-01	0.295E-02	0.982E-02	0.210E-02	0.127E-01	0.618E+00	0.484E-01	0.330E+05	1.40
9.50	0.889E-01	0.301E-02	0.100E-01	0.224E-02	0.127E-01	0.618E+00	0.484E-01	0.285E+05	1.40
9.50	0.908E-01	0.307E-02	0.102E-01	0.237E-02	0.127E-01	0.618E+00	0.484E-01	0.249E+05	1.40
9.50	0.925E-01	0.312E-02	0.104E-01	0.249E-02	0.127E-01	0.618E+00	0.484E-01	0.221E+05	1.40
9.50	0.941E-01	0.317E-02	0.106E-01	0.261E-02	0.127E-01	0.618E+00	0.484E-01	0.194E+05	1.40
9.50	0.956E-01	0.321E-02	0.107E-01	0.272E-02	0.127E-01	0.618E+00	0.484E-01	0.180E+05	1.40
9.50	0.968E-01	0.325E-02	0.109E-01	0.282E-02	0.127E-01	0.618E+00	0.484E-01	0.165E+05	1.40
9.50	0.978E-01	0.328E-02	0.110E-01	0.290E-02	0.127E-01	0.618E+00	0.484E-01	0.154E+05	1.40
9.50	0.988E-01	0.331E-02	0.112E-01	0.297E-02	0.127E-01	0.618E+00	0.484E-01	0.145E+05	1.40
9.50	0.999E-01	0.333E-02	0.113E-01	0.302E-02	0.127E-01	0.618E+00	0.484E-01	0.139E+05	1.40
9.50	0.101E+00	0.334E-02	0.114E-01	0.306E-02	0.127E-01	0.618E+00	0.484E-01	0.135E+05	1.40
9.50	0.102E+00	0.335E-02	0.114E-01	0.308E-02	0.127E-01	0.618E+00	0.484E-01	0.132E+05	1.40
9.50	0.102E+00	0.335E-02	0.115E-01	0.308E-02	0.127E-01	0.618E+00	0.484E-01	0.131E+05	1.40
9.50	0.103E+00	0.334E-02	0.115E-01	0.306E-02	0.127E-01	0.618E+00	0.484E-01	0.132E+05	1.40
9.50	0.103E+00	0.333E-02	0.115E-01	0.303E-02	0.127E-01	0.618E+00	0.484E-01	0.135E+05	1.40
9.50	0.103E+00	0.331E-02	0.115E-01	0.298E-02	0.127E-01	0.618E+00	0.484E-01	0.139E+05	1.40
9.50	0.103E+00	0.329E-02	0.115E-01	0.292E-02	0.127E-01	0.618E+00	0.484E-01	0.146E+05	1.40
9.50	0.102E+00	0.326E-02	0.115E-01	0.284E-02	0.127E-01	0.618E+00	0.484E-01	0.154E+05	1.40
9.50	0.102E+00	0.322E-02	0.114E-01	0.275E-02	0.127E-01	0.618E+00	0.484E-01	0.165E+05	1.40
9.50	0.101E+00	0.318E-02	0.114E-01	0.265E-02	0.127E-01	0.618E+00	0.484E-01	0.178E+05	1.40
9.50	0.101E+00	0.314E-02	0.113E-01	0.254E-02	0.127E-01	0.618E+00	0.484E-01	0.195E+05	1.40
9.50	0.998E-01	0.309E-02	0.113E-01	0.243E-02	0.127E-01	0.618E+00	0.484E-01	0.215E+05	1.40
9.50	0.989E-01	0.304E-02	0.112E-01	0.231E-02	0.127E-01	0.618E+00	0.484E-01	0.240E+05	1.40
9.50	0.983E-01	0.298E-02	0.111E-01	0.218E-02	0.127E-01	0.618E+00	0.484E-01	0.271E+05	1.40
9.50	0.976E-01	0.293E-02	0.110E-01	0.206E-02	0.127E-01	0.618E+00	0.484E-01	0.307E+05	1.40
9.50	0.970E-01	0.287E-02	0.109E-01	0.193E-02	0.127E-01	0.618E+00	0.484E-01	0.351E+05	1.40
9.50	0.963E-01	0.281E-02	0.108E-01	0.181E-02	0.127E-01	0.618E+00	0.484E-01	0.404E+05	1.40
9.50	0.957E-01	0.274E-02	0.108E-01	0.168E-02	0.127E-01	0.618E+00	0.484E-01	0.468E+05	1.40
9.50	0.951E-01	0.268E-02	0.107E-01	0.157E-02	0.127E-01	0.618E+00	0.484E-01	0.544E+05	1.40
9.50	0.946E-01	0.262E-02	0.106E-01	0.145E-02	0.127E-01	0.618E+00	0.484E-01	0.635E+05	1.40
9.50	0.943E-01	0.256E-02	0.106E-01	0.135E-02	0.127E-01	0.618E+00	0.484E-01	0.741E+05	1.40
9.50	0.950E-01	0.252E-02	0.107E-01	0.128E-02	0.127E-01	0.618E+00	0.484E-01	0.865E+05	1.40
9.50	0.964E-01	0.247E-02	0.108E-01	0.120E-02	0.127E-01	0.618E+00	0.484E-01	0.101E+06	1.40
9.50	0.911E-01	0.242E-02	0.111E-01	0.11[illegible]E-02	0.127E-01	0.618E+00	0.484E-01	0.117E+06	1.40
9.50	0.101E+00	0.238E-02	0.113E-01	0.105E-02	0.127E-01	0.618E+00	0.484E-01	0.134E+06	1.40
9.50	0.104E+00	0.234E-02	0.117E-01	0.974E-03	0.127E-01	0.618E+00	0.484E-01	0.152E+06	1.40
9.50	0.108E+00	0.233E-02	0.121E-01	0.[illegible]49E-03	0.127E-01	0.618E+00	0.484E-01	0.170E+06	1.40
9.50	0.115E+00	0.227E-02	0.126E-01	0.381E-02	0.127E-01	0.618E+00	0.484E-01	0.187E+06	1.40

9.50	0.124E+00	0.224E-02	0.132E-01	0.375E-02	0.127E-01	0.618E+00	0.484E-01	0.200E+06	1.40
9.50	0.133E+00	0.222E-02	0.140E-01	0.372E-02	0.127E-01	0.618E+00	0.484E-01	0.208E+06	1.40
9.50	0.138E+00	0.222E-02	0.144E-01	0.371E-02	0.127E-01	0.618E+00	0.484E-01	0.209E+06	1.40

FILE: CMB D ; A NAVAL POSTGRADUATE SCHOOL PAGE 001

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GEOMETRICAL DATA:

AREF= 0.1245E-01M2   L3= 0.5842E+00M   TETP= 9.5

A0/AREF	A1C/A0	A1/A0	A2/A0	A3/AREF	A5/AREF	A6/A5
0.2500	0.8194	0.4700	0.8269	0.4259	0.2600	3.8462

M0	M1C	M6
2.5336	2.3136	2.6634

CONSTANT LOSSES:

PID1= 0.930   PID2= 0.930   PIN= 0.960

INITIAL FLIGHT CONDITIONS:

P0(KG/M2)	T0(K)	R00(KG/M3)	PT0(KG/M2)	TT0(K)	GA
0.103E+05	0.288E+03	0.122E+01	0.186E+06	0.658E+03	1.400

TIME	M0	A5/A0	WA	WF/WA	M2	M3N	M3T	M6	TOTAL PRES. RATIOS 1C/0	12/11	3/2	4/3	6/0	GF	TT4(K)	CF	F(N)	ISP
0.76	2.53	0.570	2.615	6.902	0.362	0.161	0.177	0.391	0.996	0.771	0.934	0.939	0.558	1.25	2290.8	0.200	1136.1	6294.9
1.52	2.53	0.576	2.615	6.871	0.365	0.155	0.171	0.371	0.996	0.765	0.931	0.944	0.558	1.25	2288.0	0.200	1132.0	6300.7
2.29	2.53	0.554	2.380	7.105	0.353	0.146	0.159	0.353	0.996	0.788	0.934	0.948	0.578	1.25	2301.8	0.233	1166.5	6898.6
3.05	2.52	0.537	2.253	7.239	0.344	0.140	0.150	0.340	0.996	0.810	0.936	0.951	0.594	1.25	2309.2	0.253	1175.7	7208.7
3.81	2.53	0.531	2.128	7.384	0.341	0.135	0.144	0.329	0.996	0.817	0.936	0.954	0.605	1.25	2314.2	0.269	1161.8	7393.9
4.57	2.53	0.526	2.007	7.539	0.338	0.131	0.139	0.319	0.996	0.822	0.936	0.956	0.611	1.25	2317.0	0.281	1132.4	7495.4
5.33	2.54	0.520	1.890	7.704	0.335	0.127	0.134	0.310	0.996	0.825	0.937	0.958	0.613	1.25	2320.4	0.291	1095.6	7525.2
6.10	2.55	0.520	1.778	7.878	0.334	0.123	0.131	0.303	0.996	0.822	0.937	0.960	0.613	1.25	2316.0	0.297	1046.6	7472.6
6.86	2.56	0.515	1.671	8.061	0.330	0.120	0.127	0.297	0.996	0.823	0.938	0.961	0.611	1.25	2311.4	0.302	995.7	7391.7
7.62	2.57	0.515	1.569	8.252	0.329	0.118	0.125	0.292	0.996	0.818	0.938	0.962	0.608	1.25	2306.7	0.306	944.5	7292.6
8.38	2.59	0.520	1.473	8.452	0.331	0.115	0.124	0.287	0.996	0.807	0.937	0.963	0.604	1.25	2293.6	0.306	885.5	7111.7
9.14	2.58	0.520	1.382	8.660	0.331	0.113	0.122	0.283	0.996	0.802	0.937	0.964	0.599	1.25	2277.4	0.305	826.0	6901.3
9.90	2.59	0.526	1.296	8.875	0.333	0.112	0.122	0.280	0.996	0.791	0.936	0.964	0.593	1.26	2260.5	0.304	769.5	6689.3
10.67	2.60	0.526	1.215	9.099	0.332	0.110	0.120	0.277	0.996	0.786	0.936	0.965	0.587	1.26	2242.9	0.302	714.9	6467.1
11.43	2.61	0.531	1.139	9.330	0.334	0.109	0.120	0.274	0.996	0.775	0.935	0.965	0.581	1.26	2220.9	0.300	664.8	6257.5
12.19	2.62	0.531	1.067	9.569	0.333	0.108	0.119	0.272	0.996	0.771	0.935	0.966	0.576	1.26	2198.0	0.298	617.7	6050.4
12.95	2.62	0.537	1.000	9.816	0.336	0.106	0.119	0.270	0.995	0.761	0.934	0.966	0.571	1.26	2174.3	0.296	573.6	5845.5
13.71	2.63	0.537	0.936	10.070	0.335	0.105	0.118	0.269	0.995	0.758	0.934	0.966	0.566	1.26	2149.1	0.294	531.5	5635.6
14.48	2.63	0.537	0.877	10.332	0.335	0.105	0.117	0.267	0.995	0.755	0.934	0.967	0.562	1.26	2121.4	0.291	490.4	5410.4
15.24	2.64	0.542	0.822	10.601	0.337	0.104	0.118	0.266	0.995	0.747	0.933	0.967	0.558	1.27	2093.0	0.287	452.2	5190.2
16.00	2.64	0.542	0.770	10.877	0.337	0.103	0.117	0.265	0.995	0.745	0.933	0.967	0.554	1.27	2063.8	0.284	416.8	4975.6
16.76	2.63	0.548	0.722	11.160	0.340	0.103	0.118	0.264	0.995	0.737	0.932	0.967	0.551	1.27	2034.2	0.280	384.2	4770.2
17.52	2.61	0.542	0.677	11.450	0.338	0.102	0.117	0.264	0.995	0.750	0.933	0.967	0.562	1.27	2007.1	0.288	363.1	4687.6
18.29	2.59	0.531	0.634	11.749	0.333	0.102	0.115	0.263	0.995	0.771	0.935	0.967	0.575	1.27	1979.6	0.296	341.7	4612.2
19.05	2.58	0.526	0.595	12.052	0.332	0.102	0.115	0.263	0.996	0.785	0.935	0.967	0.589	1.28	1951.6	0.303	324.8	4530.4
19.81	2.56	0.515	0.558	12.363	0.327	0.102	0.113	0.263	0.996	0.806	0.937	0.967	0.602	1.28	1923.0	0.311	305.5	4442.7
20.57	2.55	0.509	0.524	12.681	0.326	0.101	0.113	0.263	0.996	0.821	0.937	0.967	0.615	1.28	1895.2	0.318	289.1	4352.4
21.33	2.53	0.503	0.492	13.006	0.324	0.101	0.112	0.263	0.996	0.835	0.938	0.967	0.630	1.28	1869.2	0.327	274.4	4290.4
22.10	2.52	0.492	0.462	13.337	0.320	0.101	0.111	0.263	0.996	0.858	0.939	0.967	0.645	1.28	1843.7	0.337	260.2	4224.3

```
22.86 2.50 0.481 0.43413.675 0.316 0.101 0.109 0.263 0.996 0.880 0.941 0.967 0.660 1.28 1817.9 0.346  246.5 4154.4
23.62 2.48 0.476 0.40814.020 0.315 0.101 0.109 0.263 0.996 0.895 0.941 0.967 0.675 1.29 1791.7 0.354  233.3 4081.3
```

TETA= 60.0   TIME OF BURNING= 23.62 SEC   RANGE OF BURNING=0.1091E+05 KM   HEIGHT OF BURNING=0.1598E+05 KM

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RAMJET TRAJECTORY

LPR	WPR	A30	AO/AR	A5/AR	L3	UO	U	WR	TOFV
0.155E+01	0.475E+02	0.530E-02	0.250E+00	0.260E+03	0.584E+00	0.762E+03	0.863E+03	0.199E+01	0.152E+03

TI	X3	Y3	TETA	MO	PO	RHOA	TO	MUA	WPR	DRAG	THRUST
0.762E+00	0.656E+03	0.113E+04	0.597E+02	2.534	0.103E+05	0.122E+01	0.288E+03	0.179E-04	47.5	1381.3	1136.1
0.381E+01	0.196E+04	0.332E+04	0.587E+02	2.527	0.739E+04	0.940E+00	0.270E+03	0.170E-04	47.0	1037.4	1161.8
0.686E+01	0.329E+04	0.544E+04	0.576E+02	2.557	0.553E+04	0.735E+00	0.256E+03	0.163E-04	46.7	772.0	995.7
0.990E+01	0.464E+04	0.751E+04	0.565E+02	2.593	0.412E+04	0.569E+00	0.242E+03	0.158E-04	46.5	561.8	769.5
0.130E+02	0.601E+04	0.952E+04	0.553E+02	2.623	0.307E+04	0.439E+00	0.229E+03	0.153E-04	46.3	425.4	577.6
0.160E+02	0.740E+04	0.115E+05	0.540E+02	2.639	0.230E+04	0.338E+00	0.218E+03	0.148E-04	46.3	320.5	416.8
0.190E+02	0.879E+04	0.133E+05	0.527E+02	2.579	0.173E+04	0.261E+00	0.217E+03	0.141E-04	46.2	243.8	324.8
0.221E+02	0.102E+05	0.151E+05	0.513E+02	2.516	0.132E+04	0.203E+00	0.217E+03	0.141E-04	46.2	187.1	260.2
0.251E+02	0.116E+05	0.168E+05	0.498E+02	2.441	0.101E+04	0.159E+00	0.217E+03	0.141E-04	46.2	143.4	0.0
0.282E+02	0.130E+05	0.184E+05	0.482E+02	2.335	0.786E+03	0.125E+00	0.217E+03	0.141E-04	46.2	109.0	0.0
0.312E+02	0.144E+05	0.199E+05	0.464E+02	2.238	0.621E+03	0.101E+00	0.217E+03	0.141E-04	46.2	83.9	0.0
0.343E+02	0.158E+05	0.213E+05	0.446E+02	2.149	0.498E+03	0.821E-01	0.217E+03	0.141E-04	46.2	65.7	0.0
0.373E+02	0.171E+05	0.226E+05	0.425E+02	2.065	0.405E+03	0.675E-01	0.217E+03	0.141E-04	46.2	52.2	0.0
0.404E+02	0.185E+05	0.237E+05	0.404E+02	1.986	0.334E+03	0.563E-01	0.217E+03	0.141E-04	46.2	42.1	0.0
0.434E+02	0.198E+05	0.248E+05	0.380E+02	1.913	0.279E+03	0.476E-01	0.217E+03	0.141E-04	46.2	34.6	0.0
0.465E+02	0.212E+05	0.258E+05	0.356E+02	1.844	0.237E+03	0.407E-01	0.217E+03	0.141E-04	46.2	28.8	0.0
0.495E+02	0.225E+05	0.267E+05	0.329E+02	1.780	0.205E+03	0.354E-01	0.217E+03	0.141E-04	46.2	24.2	0.0
0.526E+02	0.238E+05	0.275E+05	0.300E+02	1.723	0.179E+03	0.311E-01	0.217E+03	0.141E-04	46.2	13.3	0.0
0.556E+02	0.252E+05	0.282E+05	0.270E+02	1.670	0.159E+03	0.278E-01	0.217E+03	0.141E-04	46.2	11.7	0.0
0.587E+02	0.265E+05	0.289E+05	0.238E+02	1.623	0.143E+03	0.251E-01	0.217E+03	0.141E-04	46.2	10.4	0.0
0.617E+02	0.278E+05	0.294E+05	0.204E+02	1.582	0.131E+03	0.231E-01	0.217E+03	0.141E-04	46.2	9.4	0.0
0.648E+02	0.291E+05	0.298E+05	0.169E+02	1.546	0.121E+03	0.215E-01	0.217E+03	0.141E-04	46.2	8.6	0.0
0.678E+02	0.305E+05	0.302E+05	0.132E+02	1.516	0.114E+03	0.203E-01	0.217E+03	0.141E-04	46.2	8.0	0.0
0.709E+02	0.318E+05	0.304E+05	0.945E+01	1.493	0.109E+03	0.196E-01	0.217E+03	0.141E-04	46.2	7.4	0.0
0.739E+02	0.331E+05	0.306E+05	0.557E+01	1.476	0.106E+03	0.188E-01	0.217E+03	0.141E-04	46.2	7.1	0.0
0.770E+02	0.344E+05	0.307E+05	0.163E+01	1.465	0.104E+03	0.185E-01	0.217E+03	0.141E-04	46.2	7.0	0.0
0.800E+02	0.358E+05	0.307E+05	-0.233E+01	1.461	0.104E+03	0.185E-01	0.217E+03	0.141E-04	46.2	6.9	0.0
0.830E+02	0.371E+05	0.305E+05	-0.628E+01	1.464	0.105E+03	0.188E-01	0.217E+03	0.141E-04	46.2	7.0	0.0
0.861E+02	0.384E+05	0.303E+05	-0.102E+02	1.474	0.109E+03	0.193E-01	0.217E+03	0.141E-04	46.2	7.3	0.0
0.891E+02	0.397E+05	0.300E+05	-0.140E+02	1.491	0.114E+03	0.202E-01	0.217E+03	0.141E-04	46.2	7.6	0.0
0.922E+02	0.410E+05	0.297E+05	-0.177E+02	1.514	0.121E+03	0.213E-01	0.217E+03	0.141E-04	46.2	8.4	0.0
0.952E+02	0.423E+05	0.292E+05	-0.213E+02	1.544	0.130E+03	0.229E-01	0.217E+03	0.141E-04	46.2	9.1	0.0
0.983E+02	0.436E+05	0.286E+05	-0.247E+02	1.579	0.142E+03	0.249E-01	0.217E+03	0.141E-04	46.2	10.0	0.0
0.101E+03	0.449E+05	0.280E+05	-0.279E+02	1.620	0.157E+03	0.275E-01	0.217E+03	0.141E-04	46.2	11.2	0.0
0.104E+03	0.462E+05	0.272E+05	-0.310E+02	1.665	0.177E+03	0.307E-01	0.217E+03	0.141E-04	46.2	12.7	0.0
0.107E+03	0.475E+05	0.264E+05	-0.339E+02	1.714	0.201E+03	0.348E-01	0.217E+03	0.141E-04	46.2	14.6	0.0
0.110E+03	0.488E+05	0.255E+05	-0.366E+02	1.765	0.233E+03	0.400E-01	0.217E+03	0.141E-04	46.2	26.8	0.0
0.114E+03	0.501E+05	0.245E+05	-0.392E+02	1.819	0.273E+03	0.465E-01	0.217E+03	0.141E-04	46.2	31.8	0.0
0.117E+03	0.513E+05	0.234E+05	-0.416E+02	1.875	0.324E+03	0.549E-01	0.217E+03	0.141E-04	46.2	38.3	0.0
0.120E+03	0.526E+05	0.222E+05	-0.438E+02	1.933	0.390E+03	0.652E-01	0.217E+03	0.141E-04	46.2	46.5	0.0
0.123E+03	0.539E+05	0.209E+05	-0.459E+02	1.992	0.475E+03	0.786E-01	0.217E+03	0.141E-04	46.2	57.0	0.0
0.126E+03	0.551E+05	0.196E+05	-0.479E+02	2.051	0.586E+03	0.957E-01	0.217E+03	0.141E-04	46.2	70.8	0.0
0.129E+03	0.564E+05	0.181E+05	-0.497E+02	2.108	0.731E+03	0.119E+00	0.217E+03	0.141E-04	46.2	88.6	0.0
0.132E+03	0.576E+05	0.166E+05	-0.515E+02	2.164	0.921E+03	0.146E+00	0.217E+03	0.141E-04	46.2	111.6	0.0
0.135E+03	0.588E+05	0.150E+05	-0.531E+02	2.215	0.117E+04	0.182E+00	0.217E+03	0.141E-04	46.2	141.1	0.0
0.138E+03	0.600E+05	0.134E+05	-0.546E+02	2.261	0.150E+04	0.229E+00	0.217E+03	0.141E-04	46.2	179.3	0.0
0.141E+03	0.612E+05	0.117E+05	-0.561E+02	2.300	0.194E+04	0.290E+00	0.217E+03	0.141E-04	46.2	227.6	0.0
0.144E+03	0.623E+05	0.994E+04	-0.575E+02	2.307	0.252E+04	0.367E+00	0.221E+03	0.149E-04	46.2	290.1	0.0
0.147E+03	0.634E+05	0.815E+04	-0.588E+02	2.266	0.327E+04	0.464E+00	0.232E+03	0.154E-04	46.2	368.6	0.0
0.150E+03	0.645E+05	0.633E+04	-0.601E+02	2.208	0.425E+04	0.585E+00	0.244E+03	0.158E-04	46.2	462.0	0.0
0.153E+03	0.655E+05	0.450E+04	-0.613E+02	2.134	0.550E+04	0.732E+00	0.256E+03	0.163E-04	46.2	570.8	0.0
0.156E+03	0.665E+05	0.270E+04	-0.626E+02	2.037	0.714E+04	0.901E+00	0.268E+03	0.168E-04	46.2	713.4	0.0
0.159E+03	0.674E+05	0.927E+03	-0.638E+02	1.924	0.945E+04	0.103E+01	0.280E+03	0.174E-04	46.2	831.0	0.0
0.162E+03	0.680E+05	-0.355E+03	-0.647E+02	1.831	0.103E+05	0.122E+01	[illegible]	0.179E-04	46.2	899.4	0.0

1

RAMJET TRAJECTORY

(DRAG COEF.)

LPR	WPR	A30	AO/AR	A5/AR	L3	UO	U	WB	TOFV
0.155E+01	0.475E+02	0.530E-02	0.250E+03	0.260E+03	0.584E+00	0.762E+03	0.863E+03	0.199E+01	0.152E+03

TETP	CDN	CDS	CDWW	CDWF	APR	SPR	SWW	Q	XMO
9.50	0.864E-01	0.210E-02	0.974E-02	0.346E-02	0.127E-01	0.618E+00	0.484E-01	0.456E+06	1.40
9.50	0.866E-01	0.217E-02	0.977E-02	0.361E-02	0.127E-01	0.618E+00	0.484E-01	0.326E+06	1.40
9.50	0.856E-01	0.224E-02	0.966E-02	0.376E-02	0.127E-01	0.618E+00	0.484E-01	0.247E+06	1.40
9.50	0.843E-01	0.232E-02	0.953E-02	0.975E-03	0.127E-01	0.618E+00	0.484E-01	0.187E+06	1.40
9.50	0.824E-01	0.241E-02	0.942E-02	0.110E-02	0.127E-01	0.618E+00	0.484E-01	0.139E+06	1.40
9.50	0.829E-01	0.250E-02	0.936E-02	0.125E-02	0.127E-01	0.618E+00	0.484E-01	0.103E+06	1.40
9.50	0.848E-01	0.259E-02	0.958E-02	0.140E-02	0.127E-01	0.618E+00	0.484E-01	0.760E+05	1.40
9.50	0.870E-01	0.271E-02	0.981E-02	0.161E-02	0.127E-01	0.618E+00	0.484E-01	0.562E+05	1.40
9.50	0.896E-01	0.283E-02	0.101E-01	0.185E-02	0.127E-01	0.618E+00	0.484E-01	0.414E+05	1.40
9.50	0.938E-01	0.296E-02	0.105E-01	0.212E-02	0.127E-01	0.618E+00	0.484E-01	0.309E+05	1.40
9.50	0.976E-01	0.309E-02	0.110E-01	0.242E-02	0.127E-01	0.618E+00	0.484E-01	0.221E+05	1.40
9.50	0.102E+00	0.322E-02	0.115E-01	0.274E-02	0.127E-01	0.618E+00	0.484E-01	0.166E+05	1.40
9.50	0.107E+00	0.335E-02	0.119E-01	0.308E-02	0.127E-01	0.618E+00	0.484E-01	0.126E+05	1.40
9.50	0.112E+00	0.348E-02	0.124E-01	0.344E-02	0.127E-01	0.618E+00	0.484E-01	0.971E+04	1.40
9.50	0.119E+00	0.361E-02	0.129E-01	0.392E-02	0.127E-01	0.618E+00	0.484E-01	0.761E+04	1.40
9.50	0.126E+00	0.374E-02	0.134E-01	0.420E-02	0.127E-01	0.618E+00	0.484E-01	0.606E+04	1.40
9.50	0.132E+00	0.386E-02	0.139E-01	0.459E-02	0.127E-01	0.618E+00	0.484E-01	0.490E+04	1.40
9.50	0.137E+00	0.101E-02	0.144E-01	0.497E-02	0.127E-01	0.618E+00	0.484E-01	0.404E+04	1.40
9.50	0.142E+00	0.104E-02	0.148E-01	0.535E-02	0.127E-01	0.618E+00	0.484E-01	0.339E+04	1.40
9.50	0.147E+00	0.115E-02	0.153E-01	0.570E-02	0.127E-01	0.618E+00	0.484E-01	0.289E+04	1.40
9.50	0.151E+00	0.122E-02	0.158E-01	0.603E-02	0.127E-01	0.618E+00	0.484E-01	0.252E+04	1.40
9.50	0.155E+00	0.128E-02	0.162E-01	0.632E-02	0.127E-01	0.618E+00	0.484E-01	0.224E+04	1.40
9.50	0.157E+00	0.131E-02	0.165E-01	0.657E-02	0.127E-01	0.618E+00	0.484E-01	0.203E+04	1.40
9.50	0.153E+00	0.137E-02	0.168E-01	0.677E-02	0.127E-01	0.618E+00	0.484E-01	0.189E+04	1.40
9.50	0.154E+00	0.140E-02	0.170E-01	0.691E-02	0.127E-01	0.618E+00	0.484E-01	0.179E+04	1.40
9.50	0.155E+00	0.141E-02	0.172E-01	0.699E-02	0.127E-01	0.618E+00	0.484E-01	0.174E+04	1.40
9.50	0.155E+00	0.142E-02	0.172E-01	0.700E-02	0.127E-01	0.618E+00	0.484E-01	0.173E+04	1.40
9.50	0.155E+00	0.141E-02	0.172E-01	0.694E-02	0.127E-01	0.618E+00	0.484E-01	0.176E+04	1.40
9.50	0.154E+00	0.138E-02	0.170E-01	0.682E-02	0.127E-01	0.618E+00	0.484E-01	0.184E+04	1.40
9.50	0.153E+00	0.134E-02	0.168E-01	0.664E-02	0.127E-01	0.618E+00	0.484E-01	0.196E+04	1.40
9.50	0.158E+00	0.130E-02	0.165E-01	0.641E-02	0.127E-01	0.618E+00	0.484E-01	0.214E+04	1.40
9.50	0.155E+00	0.124E-02	0.162E-01	0.613E-02	0.127E-01	0.618E+00	0.484E-01	0.239E+04	1.40
9.50	0.151E+00	0.118E-02	0.158E-01	0.581E-02	0.127E-01	0.618E+00	0.484E-01	0.272E+04	1.40
9.50	0.147E+00	0.111E-02	0.153E-01	0.546E-02	0.127E-01	0.618E+00	0.484E-01	0.315E+04	1.40
9.50	0.143E+00	0.103E-02	0.149E-01	0.509E-02	0.127E-01	0.618E+00	0.484E-01	0.372E+04	1.40
9.50	0.138E+00	0.955E-03	0.144E-01	0.471E-02	0.127E-01	0.618E+00	0.484E-01	0.447E+04	1.40
9.50	0.133E+00	0.378E-02	0.140E-01	0.433E-02	0.127E-01	0.618E+00	0.484E-01	0.545E+04	1.40
9.50	0.128E+00	0.366E-02	0.136E-01	0.396E-02	0.127E-01	0.618E+00	0.484E-01	0.673E+04	1.40
9.50	0.123E+00	0.353E-02	0.131E-01	0.359E-02	0.127E-01	0.618E+00	0.484E-01	0.842E+04	1.40
9.50	0.117E+00	0.341E-02	0.127E-01	0.324E-02	0.127E-01	0.618E+00	0.484E-01	0.107E+05	1.40
9.50	0.111E+00	0.329E-02	0.124E-01	0.291E-02	0.127E-01	0.618E+00	0.484E-01	0.136E+05	1.40
9.50	0.108E+00	0.316E-02	0.120E-01	0.260E-02	0.127E-01	0.618E+00	0.484E-01	0.176E+05	1.40
9.50	0.104E+00	0.304E-02	0.117E-01	0.231E-02	0.127E-01	0.618E+00	0.484E-01	0.229E+05	1.40
9.50	0.101E+00	0.292E-02	0.114E-01	0.205E-02	0.127E-01	0.618E+00	0.484E-01	0.299E+05	1.40
9.50	0.984E-01	0.281E-02	0.111E-01	0.181E-02	0.127E-01	0.618E+00	0.484E-01	0.391E+05	1.40
9.50	0.967E-01	0.270E-02	0.109E-01	0.160E-02	0.127E-01	0.618E+00	0.484E-01	0.513E+05	1.40
9.50	0.953E-01	0.260E-02	0.107E-01	0.141E-02	0.127E-01	0.618E+00	0.484E-01	0.670E+05	1.40
9.50	0.950E-01	0.252E-02	0.107E-01	0.128E-02	0.127E-01	0.618E+00	0.484E-01	0.869E+05	1.40
9.50	0.966E-01	0.244E-02	0.109E-01	0.115E-02	0.127E-01	0.618E+00	0.484E-01	0.111E+06	1.40
9.50	0.987E-01	0.237E-02	0.111E-01	0.104E-02	0.127E-01	0.618E+00	0.484E-01	0.140E+06	1.40
9.50	0.103E+00	0.231E-02	0.115E-01	0.951E-03	0.127E-01	0.618E+00	0.484E-01	0.171E+06	1.40
9.50	0.108E+00	0.225E-02	0.121E-01	0.378E-02	0.127E-01	0.618E+00	0.484E-01	0.202E+06	1.40
9.50	0.118E+00	0.222E-02	0.128E-01	0.370E-02	0.127E-01	0.618E+00	0.484E-01	0.227E+06	1.40

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  9.50      0.127E+00 0.220E-02 0.135E-01 0.367E-02 0.127E-01 0.618E+00 0.484E-01 0.237E+06   1.40
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CCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
CCC                        CCC
CCC    SOLID FUEL RAMJET   CCC
CCC                        CCC
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GEOMETRICAL DATA:

AREF= 0.1245E-01M2   L3= 0.5842E+004   TETP= 6.5

AO/AREF	AIC/AO	A1/AO	A2/AO	A3/AREF	A5/AREF	A6/A5
0.2800	0.8915	0.4700	0.8269	0.4259	0.2600	3.8462

MO	MIC	M6
2.5336	2.4093	2.6646

CONSTANT LOSSES:

PID1= 0.930   PID2= 0.920   PIN= 0.950

INITIAL FLIGHT CONDITIONS:

PO(KG/M2)	TO(K)	ROO(KG/M3)	PTO(KG/M2)	TTO(K)	GA
0.103E+05	0.288E+03	0.122E+01	0.186E+06	0.658E+03	1.400

TIME	MO	AS/AO	WA	WF/WA	M2	M3N	M3I	M4	TOTAL PRES. RATIOS 1C/0	12/11	3/2	4/3	6/0	GF	TT4(K)	CF	F(N)	ISP
0.62	2.53	0.509	2.929	6.596	0.328	0.163	0.180	0.391	0.999	0.836	0.949	0.940	0.620	1.25	2258.8	0.242	1370.6	7094.8
1.24	2.55	0.509	2.929	6.570	0.328	0.158	0.173	0.373	0.999	0.836	0.948	0.944	0.619	1.25	2255.0	0.241	1363.8	7087.8
1.87	2.55	0.503	2.761	6.703	0.324	0.151	0.164	0.357	0.999	0.835	0.948	0.948	0.623	1.25	2269.2	0.260	1370.6	7408.1
2.49	2.56	0.503	2.666	6.776	0.323	0.146	0.159	0.345	0.999	0.831	0.947	0.951	0.623	1.25	2274.1	0.267	1355.7	7505.8
3.11	2.57	0.503	2.570	6.856	0.323	0.141	0.154	0.333	0.999	0.826	0.946	0.954	0.622	1.25	2279.9	0.273	1332.6	7562.9
3.73	2.58	0.503	2.475	6.941	0.322	0.137	0.150	0.324	0.999	0.821	0.946	0.956	0.619	1.25	2286.4	0.278	1304.7	7593.7
4.35	2.59	0.503	2.382	7.032	0.321	0.134	0.146	0.315	0.999	0.815	0.945	0.958	0.615	1.25	2293.5	0.282	1273.8	7605.0
4.98	2.61	0.503	2.290	7.127	0.319	0.130	0.142	0.307	0.999	0.808	0.945	0.960	0.610	1.25	2301.2	0.285	1240.8	7601.4
5.60	2.62	0.503	2.201	7.227	0.318	0.127	0.139	0.300	0.999	0.802	0.945	0.961	0.605	1.25	2309.3	0.288	1206.7	7586.3
6.22	2.63	0.503	2.114	7.331	0.317	0.124	0.136	0.294	0.999	0.795	0.945	0.962	0.600	1.25	2316.3	0.291	1170.1	7551.9
6.84	2.64	0.503	2.029	7.440	0.316	0.122	0.133	0.289	0.999	0.788	0.945	0.964	0.593	1.25	2319.7	0.292	1129.5	7481.9
7.47	2.66	0.509	1.947	7.552	0.318	0.120	0.132	0.284	0.999	0.775	0.944	0.965	0.587	1.25	2323.3	0.292	1092.3	7407.5
8.09	2.67	0.509	1.868	7.667	0.317	0.117	0.129	0.280	0.999	0.768	0.944	0.965	0.580	1.25	2327.0	0.293	1051.0	7331.0
8.71	2.68	0.515	1.792	7.786	0.319	0.116	0.129	0.276	0.999	0.755	0.943	0.966	0.573	1.25	2326.3	0.293	1004.0	7225.8
9.33	2.69	0.515	1.718	7.908	0.318	0.114	0.127	0.272	0.999	0.748	0.943	0.967	0.566	1.25	2324.8	0.292	965.9	7108.6
9.95	2.70	0.515	1.647	8.034	0.317	0.112	0.125	0.269	0.999	0.742	0.943	0.969	0.559	1.25	2322.9	0.291	925.3	6992.1
10.58	2.71	0.520	1.579	8.163	0.319	0.111	0.124	0.266	0.999	0.730	0.942	0.968	0.553	1.25	2320.6	0.290	886.4	6877.1
11.20	2.73	0.520	1.514	8.294	0.318	0.109	0.123	0.263	0.999	0.724	0.942	0.969	0.547	1.25	2318.2	0.289	849.1	6763.8
11.82	2.74	0.526	1.451	8.429	0.320	0.108	0.123	0.261	0.999	0.713	0.941	0.969	0.541	1.25	2308.9	0.286	806.0	6591.5
12.44	2.75	0.526	1.390	8.567	0.320	0.107	0.122	0.259	0.999	0.707	0.941	0.970	0.534	1.25	2299.0	0.283	764.7	6419.4
13.06	2.76	0.531	1.333	8.707	0.322	0.106	0.122	0.257	0.999	0.696	0.940	0.970	0.527	1.26	2289.0	0.279	724.3	6241.9
13.69	2.77	0.537	1.277	8.850	0.324	0.105	0.122	0.255	0.999	0.685	0.939	0.970	0.520	1.26	2278.7	0.275	685.3	6070.8
14.31	2.77	0.537	1.224	8.996	0.324	0.104	0.121	0.253	0.999	0.680	0.940	0.971	0.514	1.26	2268.0	0.272	651.5	5905.8
14.93	2.78	0.542	1.174	9.144	0.326	0.104	0.121	0.252	0.999	0.679	0.939	0.971	0.509	1.26	2256.3	0.269	617.1	5749.3
15.55	2.79	0.542	1.125	9.295	0.326	0.103	0.120	0.250	0.999	0.666	0.939	0.971	0.503	1.26	2242.4	0.266	586.2	5603.6
16.17	2.80	0.548	1.079	9.447	0.328	0.102	0.121	0.247	0.999	0.657	0.938	0.971	0.499	1.26	2228.3	0.264	554.9	5462.1
16.80	2.80	0.548	1.035	9.604	0.328	0.101	0.120	0.249	0.999	0.654	0.938	0.972	0.494	1.26	2213.8	0.261	529.1	5324.3
17.42	2.81	0.548	0.993	9.762	0.327	0.101	0.119	0.247	0.999	0.651	0.938	0.972	0.490	1.26	2199.1	0.259	502.9	5189.9
18.04	2.81	0.554	0.952	9.922	0.330	0.100	0.120	0.246	0.999	0.642	0.937	0.972	0.487	1.26	2184.1	0.257	479.0	5058.8

18.66	2.82	0.554	0.91410.084	0.329	0.100	0.119	0.245	0.999	0.640	0.937	0.972	0.483	1.26	2168.0	0.254	453.4	4920.9
19.29	2.82	0.559	0.87710.248	0.332	0.099	0.120	0.244	0.999	0.632	0.936	0.972	0.479	1.26	2150.9	0.251	429.4	4777.4
19.91	2.83	0.559	0.84210.413	0.332	0.099	0.120	0.244	0.999	0.630	0.936	0.972	0.476	1.26	2133.6	0.248	406.7	4638.0
20.53	2.82	0.559	0.80910.581	0.332	0.098	0.119	0.243	0.999	0.628	0.936	0.972	0.472	1.27	2116.0	0.245	385.3	4502.7
21.15	2.81	0.559	0.77710.750	0.332	0.098	0.119	0.243	0.999	0.631	0.936	0.972	0.477	1.27	2099.2	0.249	371.1	4444.0
21.77	2.81	0.554	0.74610.922	0.330	0.098	0.118	0.242	0.999	0.640	0.937	0.972	0.482	1.27	2082.4	0.251	353.6	4399.2
22.40	2.80	0.554	0.71711.094	0.330	0.098	0.118	0.242	0.999	0.644	0.936	0.972	0.488	1.27	2065.5	0.255	346.4	4352.9
23.02	2.79	0.548	0.69011.268	0.328	0.098	0.117	0.241	0.999	0.653	0.937	0.972	0.494	1.27	2049.3	0.259	335.2	4312.2
23.64	2.78	0.548	0.66311.444	0.328	0.097	0.117	0.241	0.999	0.657	0.937	0.972	0.499	1.27	2033.1	0.263	324.2	4270.5
24.26	2.77	0.542	0.63811.620	0.326	0.097	0.116	0.241	0.999	0.667	0.938	0.972	0.505	1.27	2016.8	0.267	313.5	4226.6
24.88	2.77	0.537	0.61411.798	0.323	0.097	0.115	0.240	0.999	0.676	0.939	0.973	0.511	1.27	2000.4	0.271	303.1	4180.8
25.51	2.76	0.537	0.59211.978	0.324	0.097	0.115	0.240	0.999	0.680	0.939	0.973	0.516	1.28	1983.9	0.274	292.9	4133.4
26.13	2.75	0.531	0.57012.158	0.321	0.097	0.114	0.240	0.999	0.690	0.940	0.973	0.522	1.28	1967.4	0.279	283.0	4084.6
26.75	2.74	0.531	0.54912.339	0.322	0.097	0.114	0.240	0.999	0.694	0.939	0.973	0.527	1.28	1950.8	0.281	273.3	4034.5
27.37	2.73	0.526	0.52912.522	0.319	0.097	0.113	0.240	0.999	0.704	0.940	0.973	0.533	1.28	1934.1	0.284	264.0	3983.4
27.99	2.73	0.526	0.51012.705	0.320	0.097	0.114	0.240	0.999	0.708	0.940	0.973	0.539	1.28	1918.0	0.287	255.2	3935.8
28.62	2.72	0.520	0.49212.889	0.317	0.096	0.113	0.240	0.999	0.718	0.941	0.972	0.545	1.28	1903.7	0.291	247.5	3901.2
29.24	2.71	0.515	0.47513.073	0.315	0.096	0.112	0.239	0.999	0.728	0.942	0.972	0.551	1.28	1889.3	0.295	240.1	3865.5
29.86	2.70	0.515	0.45913.258	0.315	0.096	0.112	0.239	0.999	0.732	0.942	0.972	0.557	1.28	1875.0	0.299	232.9	3829.0
30.49	2.70	0.509	0.44313.444	0.313	0.096	0.111	0.239	0.999	0.742	0.942	0.972	0.563	1.28	1860.7	0.303	225.8	3791.6
31.11	2.69	0.509	0.42813.630	0.314	0.096	0.111	0.239	0.999	0.746	0.942	0.972	0.568	1.28	1846.4	0.307	219.0	3753.6
31.73	2.68	0.503	0.41413.816	0.311	0.096	0.110	0.239	0.999	0.756	0.943	0.972	0.574	1.29	1832.1	0.310	212.4	3715.0
32.35	2.68	0.503	0.40014.003	0.312	0.096	0.111	0.239	0.999	0.760	0.943	0.972	0.580	1.29	1817.8	0.313	206.0	3676.0
32.97	2.67	0.498	0.38714.189	0.309	0.096	0.110	0.240	0.999	0.770	0.944	0.972	0.586	1.29	1803.5	0.317	199.8	3636.6
33.59	2.66	0.498	0.37514.376	0.310	0.096	0.110	0.240	0.999	0.774	0.943	0.972	0.592	1.29	1789.2	0.320	193.8	3597.0
34.22	2.65	0.492	0.36314.562	0.308	0.096	0.109	0.240	0.999	0.785	0.944	0.972	0.597	1.29	1775.0	0.323	188.0	3557.3
34.84	2.65	0.492	0.35214.749	0.308	0.096	0.110	0.240	0.999	0.788	0.944	0.972	0.603	1.29	1760.9	0.326	182.4	3517.4
35.46	2.64	0.487	0.34114.935	0.306	0.096	0.109	0.240	0.999	0.799	0.945	0.972	0.608	1.29	1746.7	0.329	177.0	3477.5
36.08	2.63	0.487	0.33015.120	0.307	0.096	0.109	0.240	0.999	0.803	0.945	0.972	0.614	1.29	1732.7	0.332	171.8	3437.7
36.70	2.63	0.481	0.32115.305	0.304	0.096	0.108	0.240	0.999	0.813	0.946	0.972	0.619	1.29	1718.7	0.334	166.7	3398.0
37.33	2.62	0.481	0.31115.490	0.305	0.096	0.108	0.240	0.999	0.817	0.945	0.972	0.625	1.29	1704.8	0.337	161.9	3358.5
37.95	2.61	0.476	0.30215.673	0.303	0.096	0.108	0.240	0.999	0.827	0.946	0.972	0.630	1.29	1691.0	0.339	157.2	3319.2
38.57	2.61	0.476	0.29415.856	0.303	0.096	0.108	0.240	0.999	0.831	0.946	0.972	0.635	1.30	1677.2	0.342	152.7	3280.1
39.19	2.60	0.473	0.28516.038	0.302	0.096	0.108	0.240	0.999	0.838	0.946	0.972	0.640	1.30	1663.6	0.344	148.3	3241.3

TETA= 45.0 TIME OF BURNING= 39.19 SEC RANGE OF BURNING=0.2679E+05 KM HEIGHT OF BURNING=0.1878E+05 KM

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RAMJET TRAJECTORY

LPR	WPR	A30	AO/AR	A5/AR	L3	UO	U	WR	TOFV
0.155E+01	0.475E+02	0.530E-02	0.280E+00	0.260E+00	0.584E+00	0.762E+03	0.863E+03	0.199E+01	0.124E+03

TT	X3	Y3	TETA	MO	PO	RHOA	TO	MUA	WPR	DRAG	THRUST
0.622E+00	0.760E+03	0.756E+03	0.447E+02	2.534	0.113E+05	0.122E+01	0.288E+03	0.179E-04	47.5	1226.7	1370.6
0.311E+01	0.230E+04	0.224E+04	0.435E+02	2.572	0.831E+04	0.104E+01	0.276E+03	0.172E-04	47.0	1028.7	1332.6
0.560E+01	0.386E+04	0.369E+04	0.424E+02	2.619	0.687E+04	0.884E+00	0.266E+03	0.168E-04	46.7	881.0	1206.7
0.809E+01	0.546E+04	0.511E+04	0.411E+02	2.669	0.566E+04	0.749E+00	0.257E+03	0.164E-04	46.5	750.5	1050.0
0.106E+02	0.708E+04	0.649E+04	0.399E+02	2.715	0.456E+04	0.633E+00	0.248E+03	0.160E-04	46.3	630.1	886.4
0.131E+02	0.874E+04	0.783E+04	0.386E+02	2.756	0.384E+04	0.534E+00	0.239E+03	0.156E-04	46.1	509.7	724.3
0.156E+02	0.104E+05	0.913E+04	0.374E+02	2.789	0.317E+04	0.451E+00	0.231E+03	0.153E-04	46.0	420.5	586.2
0.180E+02	0.121E+05	0.104E+05	0.360E+02	2.814	0.264E+04	0.382E+00	0.223E+03	0.150E-04	46.0	361.6	479.0
0.205E+02	0.138E+05	0.116E+05	0.347E+02	2.821	0.220E+04	0.325E+00	0.217E+03	0.141E-04	45.9	301.0	385.3
0.230E+02	0.155E+05	0.127E+05	0.333E+02	2.789	0.185E+04	0.277E+00	0.217E+03	0.141E-04	45.9	259.2	335.2
0.255E+02	0.172E+05	0.134E+05	0.318E+02	2.758	0.157E+04	0.238E+00	0.217E+03	0.141E-04	45.9	222.2	292.9
0.280E+02	0.189E+05	0.144E+05	0.303E+02	2.727	0.134E+04	0.206E+00	0.217E+03	0.141E-04	45.9	191.6	255.2
0.305E+02	0.207E+05	0.154E+05	0.288E+02	2.697	0.115E+04	0.179E+00	0.217E+03	0.141E-04	45.9	166.3	225.4
0.330E+02	0.224E+05	0.167E+05	0.273E+02	2.669	0.995E+03	0.157E+00	0.217E+03	0.141E-04	45.9	145.3	195.8
0.355E+02	0.242E+05	0.176E+05	0.257E+02	2.641	0.862E+03	0.138E+00	0.217E+03	0.141E-04	45.9	127.8	177.0
0.379E+02	0.259E+05	0.184E+05	0.240E+02	2.614	0.765E+03	0.123E+00	0.217E+03	0.141E-04	45.9	113.3	157.2
0.404E+02	0.277E+05	0.191E+05	0.224E+02	2.587	0.679E+03	0.111E+00	0.217E+03	0.141E-04	45.9	100.8	0.0
0.429E+02	0.294E+05	0.198E+05	0.206E+02	2.534	0.609E+03	0.991E-01	0.217E+03	0.141E-04	45.9	89.5	0.0
0.454E+02	0.311E+05	0.204E+05	0.188E+02	2.490	0.552E+03	0.905E-01	0.217E+03	0.141E-04	45.9	80.3	0.0
0.479E+02	0.329E+05	0.210E+05	0.170E+02	2.449	0.505E+03	0.832E-01	0.217E+03	0.141E-04	45.9	72.8	0.0
0.504E+02	0.346E+05	0.215E+05	0.151E+02	2.413	0.467E+03	0.772E-01	0.217E+03	0.141E-04	45.9	66.6	0.0
0.529E+02	0.363E+05	0.219E+05	0.132E+02	2.379	0.435E+03	0.724E-01	0.217E+03	0.141E-04	45.9	61.5	0.0
0.554E+02	0.380E+05	0.223E+05	0.113E+02	2.349	0.410E+03	0.684E-01	0.217E+03	0.141E-04	45.9	57.5	0.0
0.579E+02	0.396E+05	0.225E+05	0.926E+01	2.322	0.390E+03	0.653E-01	0.217E+03	0.141E-04	45.9	54.2	0.0
0.603E+02	0.413E+05	0.228E+05	0.723E+01	2.299	0.375E+03	0.629E-01	0.217E+03	0.141E-04	45.9	51.7	0.0
0.628E+02	0.430E+05	0.230E+05	0.517E+01	2.279	0.364E+03	0.611E-01	0.217E+03	0.141E-04	45.9	49.8	0.0
0.653E+02	0.447E+05	0.231E+05	0.309E+01	2.263	0.357E+03	0.599E-01	0.217E+03	0.141E-04	45.9	48.4	0.0
0.678E+02	0.463E+05	0.231E+05	0.991E+00	2.249	0.353E+03	0.593E-01	0.217E+03	0.141E-04	45.9	47.5	0.0
0.703E+02	0.480E+05	0.231E+05	-0.112E+01	2.238	0.352E+03	0.593E-01	0.217E+03	0.141E-04	45.9	47.2	0.0
0.728E+02	0.496E+05	0.230E+05	-0.324E+01	2.231	0.356E+03	0.598E-01	0.217E+03	0.141E-04	45.9	47.3	0.0
0.753E+02	0.512E+05	0.229E+05	-0.536E+01	2.227	0.362E+03	0.608E-01	0.217E+03	0.141E-04	45.9	47.9	0.0
0.778E+02	0.529E+05	0.227E+05	-0.748E+01	2.225	0.372E+03	0.624E-01	0.217E+03	0.141E-04	45.9	49.0	0.0
0.803E+02	0.545E+05	0.225E+05	-0.958E+01	2.227	0.387E+03	0.647E-01	0.217E+03	0.141E-04	45.9	50.6	0.0
0.827E+02	0.561E+05	0.222E+05	-0.117E+02	2.231	0.405E+03	0.676E-01	0.217E+03	0.141E-04	45.9	52.7	0.0
0.852E+02	0.577E+05	0.218E+05	-0.137E+02	2.238	0.429E+03	0.713E-01	0.217E+03	0.141E-04	45.9	55.5	0.0
0.877E+02	0.593E+05	0.214E+05	-0.158E+02	2.247	0.458E+03	0.759E-01	0.217E+03	0.141E-04	45.9	59.0	0.0
0.902E+02	0.609E+05	0.209E+05	-0.178E+02	2.258	0.493E+03	0.814E-01	0.217E+03	0.141E-04	45.9	63.2	0.0
0.927E+02	0.625E+05	0.203E+05	-0.198E+02	2.271	0.536E+03	0.880E-01	0.217E+03	0.141E-04	45.9	64.3	0.0
0.952E+02	0.640E+05	0.197E+05	-0.217E+02	2.286	0.588E+03	0.960E-01	0.217E+03	0.141E-04	45.9	74.5	0.0
0.977E+02	0.656E+05	0.191E+05	-0.236E+02	2.302	0.651E+03	0.105E+00	0.217E+03	0.141E-04	45.9	81.9	0.0
0.100E+03	0.671E+05	0.184E+05	-0.255E+02	2.320	0.726E+03	0.117E+00	0.217E+03	0.141E-04	45.9	90.8	0.0
0.103E+03	0.687E+05	0.176E+05	-0.273E+02	2.338	0.817E+03	0.131E+00	0.217E+03	0.141E-04	45.9	101.3	0.0
0.105E+03	0.702E+05	0.164E+05	-0.291E+02	2.356	0.927E+03	0.147E+00	0.217E+03	0.141E-04	45.9	113.8	0.0
0.108E+03	0.717E+05	0.159E+05	-0.309E+02	2.374	0.116E+04	0.166E+00	0.217E+03	0.141E-04	45.9	124.6	0.0
0.110E+03	0.732E+05	0.149E+05	-0.326E+02	2.392	0.122E+04	0.189E+00	0.217E+03	0.141E-04	45.9	146.1	0.0
0.113E+03	0.747E+05	0.140E+05	-0.342E+02	2.409	0.141E+04	0.217E+00	0.217E+03	0.141E-04	45.9	166.8	0.0
0.115E+03	0.761E+05	0.129E+05	-0.358E+02	2.422	0.165E+04	0.250E+00	0.217E+03	0.141E-04	45.9	191.1	0.0
0.118E+03	0.775E+05	0.119E+05	-0.374E+02	2.434	0.194E+04	0.289E+00	0.217E+03	0.141E-04	45.9	219.6	0.0
0.120E+03	0.790E+05	0.108E+05	-0.389E+02	2.441	0.228E+04	0.336E+00	0.217E+03	0.141E-04	45.9	252.8	0.0
0.123E+03	0.803E+05	0.960E+04	-0.404E+02	2.406	0.271E+04	0.391E+00	0.224E+03	0.150E-04	45.9	294.6	0.0
0.125E+03	0.817E+05	0.842E+04	-0.419E+02	2.365	0.322E+04	0.457E+00	0.231E+03	0.153E-04	45.9	341.5	0.0
0.128E+03	0.830E+05	0.720E+04	-0.433E+02	2.316	0.383E+04	0.534E+00	0.239E+03	0.156E-04	45.9	394.8	0.0
0.130E+03	0.843E+05	0.595E+04	-0.448E+02	2.260	0.457E+04	0.623E+00	0.247E+03	0.160E-04	45.9	454.2	0.0
0.133E+03	0.855E+05	0.471E+04	-0.462E+02	2.195	0.545E+04	0.725E+00	0.255E+03	0.163E-04	45.9	519.5	0.0
0.135E+03	0.867E+05	0.345E+04	-0.476E+02	2.121	0.648E+04	0.841E+00	0.264E+03	0.167E-04	45.9	613.1	0.0
0.137E+03	0.878E+05	0.219E+04	-0.490E+02	2.037	0.766E+04	0.969E+00	0.272E+03	0.170E-04	45.9	681.3	0.0
0.140E+03	0.888E+05	0.941E+03	-0.503E+02	1.944	0.878E+04	0.111E+01	0.280E+03	0.174E-04	45.9	747.7	0.0

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0.142E+03 0.898E+05-0.290E+03-0.518E+02 1.854 0.103E+05 0.122E+01 0.288E+03 0.179E-04   45.9  798.6    0.0
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1

RAMJET TRAJECTORY

(DRAG COEF.)

LPR	WPR	A30	A0/AR	A5/AR	L3	U0	U	WA	TOEV
0.155E+01	0.475E+02	0.530E-02	0.280E+00	0.260E+03	0.584E+00	0.762E+03	0.863E+03	0.199E+01	0.124E+03

TETP	CDN	CDS	CDWW	CDWF	APR	SPP	SWW	Q	XMO
6.50	0.596E-01	0.210E-02	0.974E-02	0.346E-02	0.127E-01	0.618E+00	0.484E-01	0.456E+06	1.40
6.50	0.587E-01	0.214E-02	0.960E-02	0.355E-02	0.127E-01	0.618E+00	0.484E-01	0.381E+06	1.40
6.50	0.577E-01	0.218E-02	0.943E-02	0.363E-02	0.127E-01	0.618E+00	0.484E-01	0.325E+06	1.40
6.50	0.566E-01	0.222E-02	0.926E-02	0.372E-02	0.127E-01	0.618E+00	0.484E-01	0.276E+06	1.40
6.50	0.556E-01	0.227E-02	0.911E-02	0.382E-02	0.127E-01	0.618E+00	0.484E-01	0.233E+06	1.40
6.50	0.548E-01	0.232E-02	0.898E-02	0.975E-03	0.127E-01	0.618E+00	0.484E-01	0.195E+06	1.40
6.50	0.541E-01	0.238E-02	0.888E-02	0.105E-02	0.127E-01	0.618E+00	0.484E-01	0.163E+06	1.40
6.50	0.537E-01	0.243E-02	0.881E-02	0.114E-02	0.127E-01	0.618E+00	0.484E-01	0.136E+06	1.40
6.50	0.535E-01	0.247E-02	0.878E-02	0.120E-02	0.127E-01	0.618E+00	0.484E-01	0.113E+06	1.40
6.50	0.541E-01	0.254E-02	0.880E-02	0.131E-02	0.127E-01	0.618E+00	0.484E-01	0.944E+05	1.40
6.50	0.547E-01	0.260E-02	0.898E-02	0.142E-02	0.127E-01	0.618E+00	0.484E-01	0.792E+05	1.40
6.50	0.554E-01	0.267E-02	0.907E-02	0.154E-02	0.127E-01	0.618E+00	0.484E-01	0.670E+05	1.40
6.50	0.560E-01	0.273E-02	0.917E-02	0.166E-02	0.127E-01	0.618E+00	0.484E-01	0.569E+05	1.40
6.50	0.566E-01	0.279E-02	0.926E-02	0.178E-02	0.127E-01	0.618E+00	0.484E-01	0.488E+05	1.40
6.50	0.572E-01	0.286E-02	0.936E-02	0.191E-02	0.127E-01	0.618E+00	0.484E-01	0.421E+05	1.40
6.50	0.578E-01	0.292E-02	0.945E-02	0.203E-02	0.127E-01	0.618E+00	0.484E-01	0.367E+05	1.40
6.50	0.585E-01	0.297E-02	0.956E-02	0.216E-02	0.127E-01	0.618E+00	0.484E-01	0.320E+05	1.40
6.50	0.596E-01	0.303E-02	0.974E-02	0.230E-02	0.127E-01	0.618E+00	0.484E-01	0.279E+05	1.40
6.50	0.607E-01	0.309E-02	0.991E-02	0.243E-02	0.127E-01	0.618E+00	0.484E-01	0.245E+05	1.40
6.50	0.617E-01	0.314E-02	0.101E-01	0.255E-02	0.127E-01	0.618E+00	0.484E-01	0.218E+05	1.40
6.50	0.627E-01	0.319E-02	0.102E-01	0.267E-02	0.127E-01	0.618E+00	0.484E-01	0.197E+05	1.40
6.50	0.636E-01	0.323E-02	0.104E-01	0.279E-02	0.127E-01	0.618E+00	0.484E-01	0.179E+05	1.40
6.50	0.644E-01	0.327E-02	0.105E-01	0.287E-02	0.127E-01	0.618E+00	0.484E-01	0.165E+05	1.40
6.50	0.652E-01	0.330E-02	0.106E-01	0.296E-02	0.127E-01	0.618E+00	0.484E-01	0.154E+05	1.40
6.50	0.659E-01	0.333E-02	0.107E-01	0.303E-02	0.127E-01	0.618E+00	0.484E-01	0.145E+05	1.40
6.50	0.666E-01	0.335E-02	0.108E-01	0.309E-02	0.127E-01	0.618E+00	0.484E-01	0.139E+05	1.40
6.50	0.671E-01	0.337E-02	0.109E-01	0.313E-02	0.127E-01	0.618E+00	0.484E-01	0.134E+05	1.40
6.50	0.675E-01	0.338E-02	0.109E-01	0.315E-02	0.127E-01	0.618E+00	0.484E-01	0.131E+05	1.40
6.50	0.679E-01	0.339E-02	0.110E-01	0.316E-02	0.127E-01	0.618E+00	0.484E-01	0.130E+05	1.40
6.50	0.681E-01	0.338E-02	0.110E-01	0.315E-02	0.127E-01	0.618E+00	0.484E-01	0.130E+05	1.40
6.50	0.683E-01	0.337E-02	0.111E-01	0.313E-02	0.127E-01	0.618E+00	0.484E-01	0.132E+05	1.40
6.50	0.683E-01	0.335E-02	0.111E-01	0.309E-02	0.127E-01	0.618E+00	0.484E-01	0.135E+05	1.40
6.50	0.682E-01	0.333E-02	0.111E-01	0.303E-02	0.127E-01	0.618E+00	0.484E-01	0.140E+05	1.40
6.50	0.681E-01	0.331E-02	0.110E-01	0.297E-02	0.127E-01	0.618E+00	0.484E-01	0.147E+05	1.40
6.50	0.679E-01	0.327E-02	0.110E-01	0.288E-02	0.127E-01	0.618E+00	0.484E-01	0.156E+05	1.40
6.50	0.676E-01	0.324E-02	0.110E-01	0.279E-02	0.127E-01	0.618E+00	0.484E-01	0.167E+05	1.40
6.50	0.672E-01	0.320E-02	0.109E-01	0.269E-02	0.127E-01	0.618E+00	0.484E-01	0.181E+05	1.40
6.50	0.669E-01	0.315E-02	0.108E-01	0.258E-02	0.127E-01	0.618E+00	0.484E-01	0.198E+05	1.40
6.50	0.663E-01	0.310E-02	0.108E-01	0.246E-02	0.127E-01	0.618E+00	0.484E-01	0.219E+05	1.40
6.50	0.658E-01	0.305E-02	0.107E-01	0.234E-02	0.127E-01	0.618E+00	0.484E-01	0.245E+05	1.40
6.50	0.653E-01	0.300E-02	0.106E-01	0.221E-02	0.127E-01	0.618E+00	0.484E-01	0.275E+05	1.40
6.50	0.649E-01	0.294E-02	0.105E-01	0.209E-02	0.127E-01	0.618E+00	0.484E-01	0.312E+05	1.40
6.50	0.642E-01	0.288E-02	0.105E-01	0.196E-02	0.127E-01	0.618E+00	0.484E-01	0.356E+05	1.40
6.50	0.637E-01	0.282E-02	0.104E-01	0.183E-02	0.127E-01	0.618E+00	0.484E-01	0.409E+05	1.40
6.50	0.632E-01	0.276E-02	0.103E-01	0.171E-02	0.127E-01	0.618E+00	0.484E-01	0.473E+05	1.40
6.50	0.628E-01	0.270E-02	0.102E-01	0.159E-02	0.127E-01	0.618E+00	0.484E-01	0.550E+05	1.40
6.50	0.624E-01	0.264E-02	0.102E-01	0.148E-02	0.127E-01	0.618E+00	0.484E-01	0.641E+05	1.40
6.50	0.621E-01	0.258E-02	0.101E-01	0.137E-02	0.127E-01	0.618E+00	0.484E-01	0.748E+05	1.40
6.50	0.619E-01	0.252E-02	0.101E-01	0.127E-02	0.127E-01	0.618E+00	0.484E-01	0.875E+05	1.40
6.50	0.628E-01	0.248E-02	0.102E-01	0.122E-02	0.127E-01	0.618E+00	0.484E-01	0.102E+06	1.40
6.50	0.640E-01	0.243E-02	0.104E-01	0.114E-02	0.127E-01	0.618E+00	0.484E-01	0.119E+06	1.40
6.50	0.654E-01	0.234E-02	0.106E-01	0.106E-02	0.127E-01	0.618E+00	0.484E-01	0.138E+06	1.40
6.50	0.672E-01	0.234E-02	0.109E-01	0.999E-03	0.127E-01	0.618E+00	0.484E-01	0.158E+06	1.40

6.50	0.692E-01	0.230E-02	0.112E-01	0.941E-03	0.127E-01	0.618E+00	0.484E-01	0.180E+06	1.40
6.50	0.719E-01	0.226E-02	0.116E-01	0.380E-02	0.127E-01	0.618E+00	0.484E-01	0.201E+06	1.40
6.50	0.751E-01	0.223E-02	0.121E-01	0.374E-02	0.127E-01	0.618E+00	0.484E-01	0.220E+06	1.40
6.50	0.802E-01	0.221E-02	0.126E-01	0.369E-02	0.127E-01	0.618E+00	0.484E-01	0.236E+06	1.40
6.50	0.866E-01	0.219E-02	0.133E-01	0.366E-02	0.127E-01	0.618E+00	0.484E-01	0.244E+06	1.40

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Van Nuys, California 91409

15. Mr. George Minto 1
Martin Marietta Corporation
P.O. Box 5837 MP-86
Orlando, Florida 32855

16. Mr. Myron Tygar 1
Chemical Systems Division
United Technologies Corporation
P.O. Box 358
Sunnyvale, California 94086

17. Professor D. W. Netzer 1
Code 67Nt
Department of Aeronautics
Naval Postgraduate School
Monterey, California 93940

18. Mr. Uri Katz 1
Visiting Research Associate
Department of Aeronautics
Naval Postgraduate School
Monterey, California 93940

19. Dr. Oded Amichai 4
Visiting Research Associate
Department of Aeronautics
Naval Postgraduate School

20. Research Administration 1
Code 012A
Naval Postgraduate School

11. Commander
    Development Command
    USMCDEC
    Quantico, Virginia 22134

12. Commander
    Artillery Development Command
    Fort Sill, Oklahoma 73503

13. Mr. Art Thomas
    Vice President, Engineering
    The Marquardt Company
    16555 Saticoy Street
    Van Nuys, California 91409

14. Mr. Joseph C. Hewett
    The Marquardt Company
    16555 Saticoy Street
    Van Nuys, California 91409

15. Mr. George Hinds
    Martin Marietta Corporation
    P.O. Box 5837 MP-48
    Orlando, Florida 32855

16. Mr. Myron Tyger
    Chemical Systems Division
    United Technologies Corporation
    P.O. Box 358
    Sunnyvale, California 94086

17. Professor D. W. Netzer
    Code 67Nt
    Department of Aeronautics
    Naval Postgraduate School
    Monterey, California 93940

18. Dr. Jiri Katz
    Visiting Research Associate
    Department of Aeronautics
    Naval Postgraduate School
    Monterey, California 93940

19. Dr. Udo Reichel
    Visiting Research Associate
    Department of Aeronautics
    Naval Postgraduate School

20. Research Administration
    Code 012A
    Naval Postgraduate School